ACORN USER

Number 1 July/August 1982 £1.00



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Front cover – complex computer art from the BBC micro. The rainbow picture uses a dot-shading method, with the dots becoming denser towards the horizon to give the appearance of depth to the snow-covered grass. (See the article on page 6).



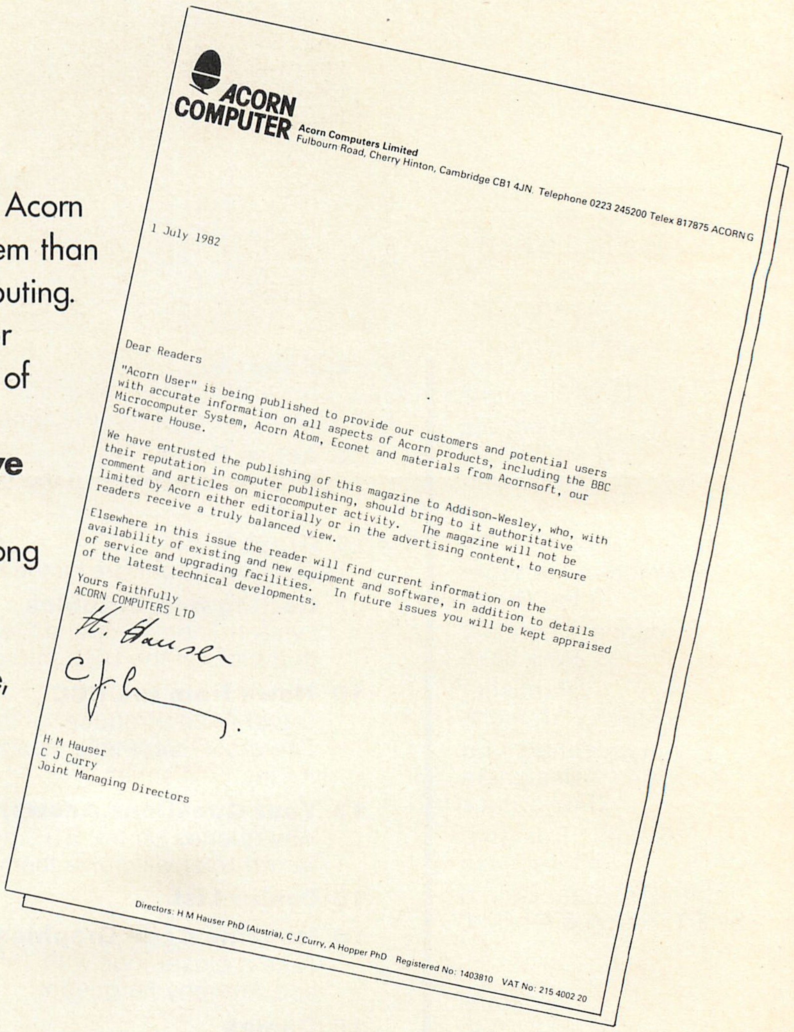
How to submit articles

You are welcome to submit articles to the Editor of *Acorn User* for publication. *Acorn User* cannot undertake to return them unless a stamped addressed envelope is enclosed. Articles should be typed or computer written. Black and white photographs or transparencies are also appreciated. If submitting programs please send a cassette or disc, together with a full listing. Payment is £50 per page or pro rata. Please indicate if you have submitted your article elsewhere.

Send articles, reviews, and information to:
The Editor, Acorn User, 53 Bedford Square, London WC1B 3DZ.

See next month's *Acorn User* for:
● Telesoftware plans from the BBC ● Review of the BBC micro, Spectrum and Electron ● Using the BBC micro in the office ● Art on the BBC micro ● ● The BBC micro goes to primary school ●

Editorial



ACORN COMPUTER

Acorn Computers Limited
Fulbourn Road, Cherry Hinton, Cambridge CB1 4JN. Telephone 0223 245200 Telex 817875 ACORN G

1 July 1982

Dear Readers

"Acorn User" is being published to provide our customers and potential users with accurate information on all aspects of Acorn products, including the BBC Microcomputer System, Acorn Atom, Econet and materials from Acornsoft, our Software House.

We have entrusted the publishing of this magazine to Addison-Wesley, who, with their reputation in computer publishing, should bring to it authoritative comment and articles on microcomputer activity. The magazine will not be limited by Acorn either editorially or in the advertising content, to ensure readers receive a truly balanced view.

Elsewhere in this issue the reader will find current information on the availability of existing and new equipment and software, in addition to details of service and upgrading facilities. In future issues you will be kept appraised of the latest technical developments.

Yours faithfully
ACORN COMPUTERS LTD

H. Hauser

C J Curry

H M Hauser
C J Curry
Joint Managing Directors

Directors: H M Hauser PhD (Austria), C J Curry, A Hopper PhD Registered No: 1403810 VAT No: 215 4002 20

More lines of copy have been written about Acorn Computers and the BBC microcomputer system than about almost any other aspect of microcomputing. Misleading information abounds and users or potential users have experienced every level of frustration in trying to obtain information. This magazine will provide an **authoritative official** source of **accurate** information.

The products of Acorn Computers are among the most sophisticated and technically advanced available in their price range. Equipment to be announced in the near future, for market sectors not covered by the existing range, is even more exciting, as is the specification for further peripherals to the BBC system. Readers will receive the earliest information on new equipment, software and applications packages.

Hardware reviews and tests

Acorn hardware and systems, and also peripherals and adaptations for Acorn equipment from other manufacturers, will be independently reviewed and tested. Where comparisons are relevant, competing hardware will also be tested. Dealers and manufacturers are invited to submit their products to the publisher for this purpose.

Electron

Our next issue will contain the first official details of the new and much vaunted Acorn Electron. What we can say now is that the new Acorn micro will not replace the BBC Model A or B, but is intended for another quite distinct market sector – that's official!

Servicing and upgrading facilities

Not all of us are electronic wizards capable of upgrading our own equipment or adding special peripherals. Each issue of **Acorn User** will carry a dealers list, will highlight new service facilities and feature dealers offering particular specialised services. For those of us who do enjoy 'opening the box' there will be regular features on how to do it yourself.

Software, books and applications packages

All the products of Acornsoft will, of course, be announced first in **Acorn User** and will be fully reviewed. We will list and review other software available commercially or through user groups. Again, you are invited to submit your programs or applications packages to the publisher for review. New books specifically related to Acorn products will automatically receive review coverage, as will other relevant publications.

BBC

The latest news about the **Computer Literacy Programme** will be featured here in **Acorn User**, written not at second or third hand but by the BBC's own staff.

Keep abreast

Keep abreast of the latest techniques and developments in microcomputing through our articles. Our sources are truly international and future issues will bring you comments from Europe, North America, the Far East and Australia.

User groups

At last there is a professionaly published national medium that Acorn User Groups can utilise to reach possible contacts and exchange information. We're only a phone call away and our service is free.

Letters

We want your letters, comments, suggestions or complaints. **Acorn User** is your soap box — we are not obliged to agree with you but we'd like to hear from you.

ACORN News

Mobile Classroom

The Acorn mobile classroom is now touring the country giving people the opportunity of first-hand experience of a complete computer network.

The classroom carries a seven-station Econet network with a System 4 file serving station and accompanying software.

Econet is a network system developed by Acorn which links together micros to enable them to use a common disc drive and printer.

In addition, each terminal is capable of intercommunication with all others on the network. This means the teacher can keep a check on exactly what is occurring over the network.

At present the terminals are provided by the Acorn Atom but it is planned to refit the caravan with the BBC micro.

The caravan is loaned to schools for a week and the service is free of charge. A technician visits the site to set up and demonstrate the unit. For the remainder of the week the school is at liberty to use the caravan as teachers see fit.

So far the caravan has proved extremely popular and its itinerary for the remainder of 1982 is fully booked, but any school which has been unsuccessful in its application will be offered an opportunity to use the caravan during 1983. Anyone who wishes to use the caravan should apply in writing outlining when they would like to use the unit and when a booking would not be poossible. All applications should be sent to Acorn Computers and marked for the attention of the Educational Services Department.

Dates and venues for the Acorn Mobile Classroom:

July 5–9,
Department of Education and Science Course, Robinson College, Cambridge.

July 19–23,
Department of Education and Science Course, Worcester College.

July 26–30,
MUSE Conference, Birmingham.

August 16–20,
Computer Week, Uxbridge.

August 23 to September 3,
Exhibition at Dingwall School.

September 6–17,
Schools' Exhibition, Glasgow.

Delivery

The good news on delivery is that we have shipped over 10,000 model A BBC microcomputers and there should be a no more than three-week delay between placing an order for a model A computer and its despatch. Unfortunately the model B situation is not as good. We had enormous problems with the Ferranti ULA which forms a vital part of the television picture generation circuit. However, this excellent chip is now available in adequate quantities and seems to be over its teething problems, so Ferranti must be given credit.

Acorn currently use two manufacturing plants in the United Kingdom. ICL at Kidsgrove are largely responsible for manufacturing the model B and Cleartone in Gwent for model A computers. Cleartone have recently been taken over by AB Electronics and we hope this may provide an even greater production capacity. A third UK manufacturing plant is starting production of both models this month to help meet the continued high demand.

Unfortunately we have only delivered about 7,000 model B computers at the time of writing and have nearly 12,000 outstanding orders.

If you have not yet received your BBC micro, please check your order number (first 3 characters) against the following latest delivery dates. Those orders beginning with N22 will be despatched by 9th July, N29 by 16th July, P12 by 23rd July, P26 by 30th July, Q5 by 6th August, Q12 by 13th August, R2 by 20th August, R23 by 27th August and S15 by 3rd September. Customers with specific enquiries about orders should write to Kettering (*not* to Acorn Computers). The address is as follows: *BBC Microcomputer Systems, 14 Station Road, Kettering, Northamptonshire NN15 7HE.*

We have started to deliver single disc drive units and hopefully they will be available on a four-week turn around by the end of summer. Dual disc drives should be available by August. A further announcement will be given in the next issue of Acorn User.

The Econet option for the BBC micro will be available during July.



Training Courses

Acorn Computers run monthly hardware training courses. Though designed mainly for dealers and Local Education Authorities, they are open to individuals. Each course costs £50 and lasts one day. The courses assume a working knowledge of digital electronics and are designed to give a thorough understanding of the circuit of the main computer and the principles of interfacing it to other devices. A substantial service manual, giving a full circuit diagram and circuit description, is presented to all participants. Applications should be sent to: *Educational Services, Acorn Computers, Fulbourn Road, Cambridge, CB1 4JN*

LOGO on the BBC Micro

Massachusetts Institute of Technology and Acorn have just agreed to implement the language LOGO on the BBC micro. LOGO was invented at MIT in 1971 by the Seymour Pappert/Hal Abelson team. Designed for people of any age who have never used a computer before, it has been used by 3-year-olds and by university students of the principles of quantum mechanics. "You should have used a recursive procedure there," one 6-year-old told another at Lamplighter School in Dallas, Texas!

MIT have agreed to provide Acorn with 6502 source code and to oversee the conversion of this code to run on the BBC micro. In fact, the code is likely to move between MIT and the

UK over the ARPAnet satellite link, enabling MIT and Acorn to stay in close touch during the development. Acorn LOGO should take 5 or 6 months to complete and it is expected to be a very complete and powerful implementation – "right from the horse's mouth".

National Semiconductor Deal

Acorn Computers and National Semiconductor are collaborating to produce a new generation of 32-bit microcomputers for the personal and small-business market. The 32-bit family, supported by massive software investment, gives National Semiconductor a technical superiority over their 16-bit rivals. The new chip is the only true 32-bit micro available today and provides the personal computer user with the power and speed previously available only from mini-computers costing ten times as much.

Acorn will use the new chips in two major products. First, as the second processor for the BBC machine. The board will be packaged with 256K bytes of RAM, and the operating system included in software in ROM to take full advantage of the sophisticated operating system of the BBC Micro. This interface will be handled by the 'Tube', a patented high-speed data channel.

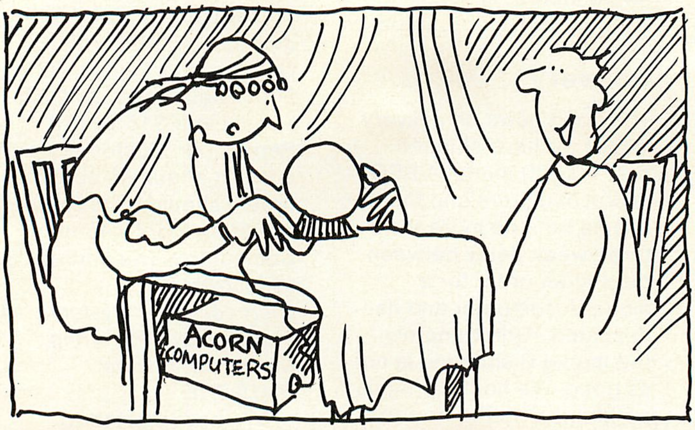
The second product is a new concept in computing. The package will be the new chip, up to 1M-byte of RAM, one or two 5M-byte mini-Winchester discs and a specialised operating system to allow the buyer to use his existing system, such as Apple, Pet or TRS 80, as a terminal. Communication would be through a simple RS232 or other suitable channel. The cost of the unit will be around US$3,500.

Extensive software support has been arranged. Users will have the choice of Acorn, Unix or Idris operating systems and the following languages will be available – PL1, Fortran 77, Pascal, C, PLM 86 followed by RPG11, Cobol, Ada, PEARL and Coral 66.

Digital Research of America is also developing a multi-task version of CP/M for the new chip.

Guidelines for Software Writers

The BBC have produced a 12-page booklet entitled *Guidelines for Software Writers* containing suggestions for program style, screen layout, program documentation and software approval. Copies are available from: *The Software Editor, BBC Educational Publications, 35 Marylebone High Street, London, W1M 4AA.* Please enclose a large s.a.e.



Exhibitions

If you would like to see the latest Acorn products or meet their sales engineers, visit the Acorn stand at the exhibitions listed below:

East of England Show, Showground, Peterborough
July 20,21,22
PCW Show, Barbican Centre,
Beech Road, London.
September 9,12
Compec' 82, Earls Court/Olympia, Warwick Road, London.
November 16,19
Motor Show, National Exhibition Centre, Birmingham
October 25,31

Leads

Two audio leads are now available to connect a cassette recorder to your BBC computer. Part number ANGO8 has 3 jack plugs to fit the cassette recorder, two 3.5mm plugs for input and output and one 2.5mm plug for motor control. Part number ANGO9 has one 5 pin DIN plug for input and output and one 2.5mm jack plug for motor control. If you have a choice, use the lead with the DIN plug (ANGO9) since there are clear standards for the voltage levels at DIN connectors. For those making up their own leads see page 14 for wiring instructions.

New User Guide

The new 550-page BBC micro *User Guide*, due this month, will be sent free of charge to all those who have returned the cards enclosed with the provisional copy. If you have already returned your card you should receive your copy by the beginning of August.

Marketing Operation to Move

The despatch operation will shortly be moving from Kettering to Wellingborough. A larger, more flexible real-time computer system is being installed to provide customers with up-to-the-minute information. Acorn will despatch all their products from Wellingborough once the new system is established. More details in the next issue of *Acorn User.*

Safety Approval

The new Astek switched mode power supplies being fitted to the BBC micro conforms fully to British Standard 415 Class 1. This computer has been submitted for safety approval to the Consortium of Local Education Authorities for the purchasing of Science Equipment (CLEAPSE), who report that the BBC micro meets all relevant safety requirements. However, although the grille below the power supply passes the 'standard probe' test, a much finer mesh is being made for future machines at the request of CLEAPSE. The BBC micro meets National and International Safety Standards but a number of safety features are being improved to satisfy particular Local Education Authority requests.

The Computer Referral Service

The Computer Referral Service, part of the BBC *Computer Literacy Project* is organised by Broadcasting Support Services, a registered charity. It helps newcomers to computers, businesses interested in the use of micros, those interested in a career in computing, and disabled people wanting to know how micros might help them. It provides information on courses, national and local organisations that offer advice or consultancy to business, computer clubs and user groups, and informal advice. (See next issue of *Acorn User* for more details.) For more information please send a large s.a.e. to: *The Computer Referral Service, P.O. Box 7, London W3 6XJ,* stating the information required.

Guarantee and Service

Guarantee Cards have gone to all owners of BBC micros and are being enclosed with machines now being sent out. The guarantee goes well beyond the legal requirements.

To obtain service under guarantee simply return the computer to your supplier or direct to *Authorised Service Agency, Retail Control Systems Ltd., Gresham House, Twickenham Road, Feltham, Middx., TW13 6HA.*

Home Micro Work Station

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I enclose cheque for.......... or charge my Access Account Number...............................

SIGNATURE..................................

Please send me......... Micro Dust Cover(s) at £2.95 including P & P (state model)

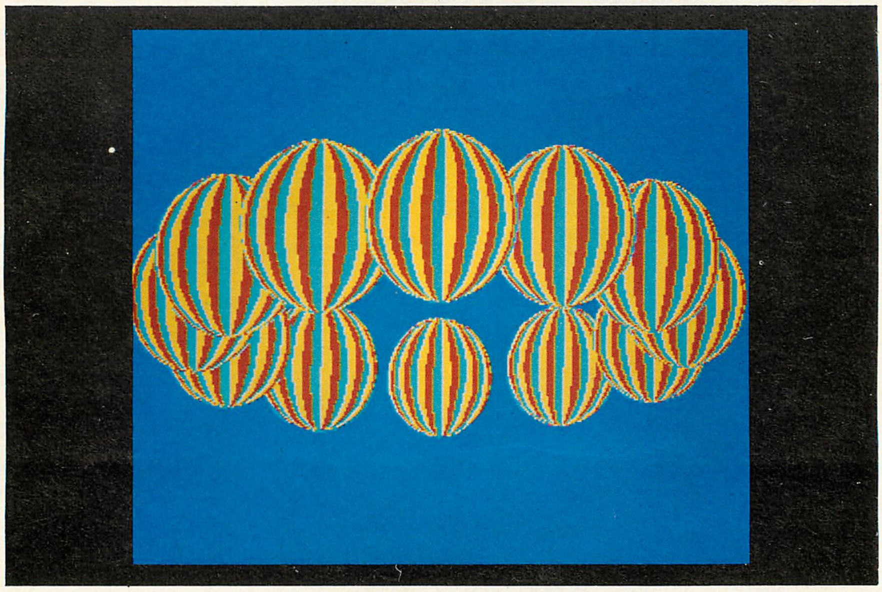
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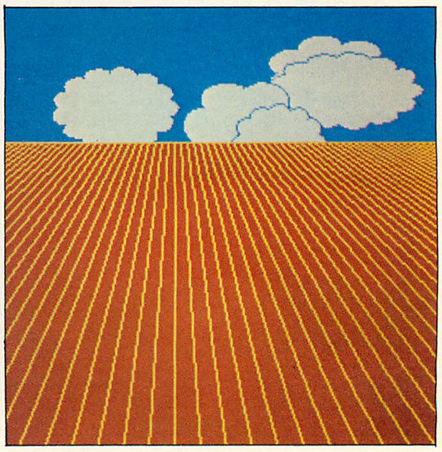
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Please allow 28 days for delivery of Work Station

....



THE GRAPHIC ART OF THE BBC MICROCOMPUTER



The book *Creative Graphics on the BBC Microcomputer* by John Counie demonstrates the possibilities of graphics with striking displays. After an introductory chapter the book launches into a series of some 40 programs, most no more than 20 lines long.

Early chapters deal with simple symmetrical patterns. The Kaleidoscope (below right) generates constantly changing reflected patterns and Persian Carpet (below left) produces a coloured pattern with a woven appearance by drawing radiating lines in different colours.

Recursion is covered to produce variations on recursive patterns like the Koch snowflake, the C-curve and the Dragon curve, all of which are simply described, using recursive procedure calls to give patterns with an intricate appearance.

A chapter on animation produces moving patterns, using palette changing. One program called Beach Balls shows a ring of striped balls which spin on their axes (above).

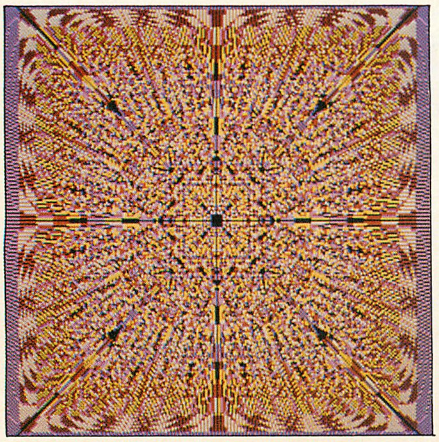
The techniques illustrated in earlier chapters are finally pulled together to create four complex pictures which demonstrate how the BBC micro can be used as a tool for generating computer art. Each picture is built up from elements generated by procedures and so the programs serve as a good illustration of modular programming.

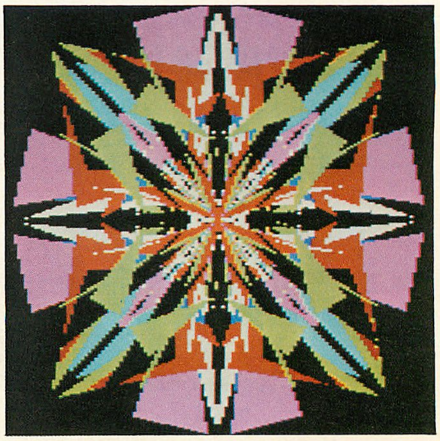
One of these pictures is shown on the front cover, and in the windy field picture, the clouds actually drift across the landscape.

The rainbow picture uses a dot-shading method, with the dots becoming denser towards the horizon to give the appearance of depth to the snow-covered grass.

The book is available from Acornsoft, 4a Market Hill, Cambridge for £7.50. A cassette containing all the programs is available for £9.95, including VAT, from the same address.

As the four pictures demonstrate, the graphics produced by simple programs will delight any user of a BBC microcomputer. For the inventive, they will provide a starting point for many types of computer art.





Getting into GRAPHICS

Lyndon Thomas, of the North East Wales Institute of Higher Education, opens the door to the techniques of drawing graphics with the BBC micro

The BBC microscreen can be thought of as a matrix of picture elements, on which images are created by setting any of these picture elements (or pixels) to the desired colour.

There may be 160, 320 or 640 pixels along the *x*-axis depending on the mode. However, it is important to note that whatever mode is selected, the screen always has 1280 x 1024 addressable points. Therefore, several addressable points will always refer to a single pixel. For a given size of screen memory, there is a trade-off between the number of bits/pixel (and hence the number of displayable colours) and the total number of pixels that can be displayed. The choice is between having a lot of colours and few pixels (e.g. mode two) or few colours and a large number of pixels (e.g. mode zero).

The next step in producing graphics is to decide on colours. This is done in two stages. First, the user can set up a palette of two, four or sixteen colours (depending on mode). Then one colour in the palette can be selected. The palette is set up using the instruction

VDU 19, < logical colour >, <actual colour>, 0, 0, 0

Logical colour is a number which the programmer uses when *selecting a colour* from his palette. It is a number in the range 0 to (n-1), where n is the total number of colours permitted in the selected mode. Actual colour is a number in the range 0 to 15 and determines the colour to be displayed when the corresponding logical colour is referred to. The correspondence between this number and the colour displayed is given in the *User Guide* under the section describing the COLOUR statement. As an example, the instructions:

```
100 VDU 19, 0, 0, 0, 0, 0
110 VDU 19, 1, 1, 0, 0, 0
120 VDU 19, 2, 4, 0, 0, 0
130 VDU 19, 3, 7, 0, 0, 0
```

set up a palette of black, red, blue and white, referred to as colours 0, 1, 2 and 3 respectively. This step would usually be omitted when using mode two, since all 16 colours are available as defaults. One of the colours can be selected from the palette using the instruction:

GCOL 0, logical colour

Thus, in the above example, if a user wishes to draw in blue, the statement GCOL 0, 2 would select the appropriate colour.

Lines in the last selected colour can be drawn on the screen using the MOVE and DRAW instructions. It should be remembered that the *x*-axis range is 0 - 1279 and the *y*-axis range is 0 - 1023, regardless of mode. The instruction DRAW X, Y draws a line from the current position (last point accessed) to point X,Y.

If the user wishes to produce solid blocks of colour instead of line drawings, there are several approaches.

The first is to fill in the area with lines of appropriate colour. For example, to produce a solid circle radius R centre XCENTRE, YCENTRE, the following procedure could be used:

```
1000 DEFPROCCIRCLE(XCENTRE,YCENTRE,R)
1010 FOR X=XCENTRE-R TO XCENTRE+R STEP 4
1020 Y=SQR(R*R - (XCENTRE-X)^2)
1030 MOVE X,YCENTRE-Y
1040 DRAW X,YCENTRE+Y
1050 NEXT X
1060 ENDPROC
1999 END
```

Note that the step size in line 1010 depends on the selected mode. The step size should be 1280÷number of pixels along *x*-axis in the chosen mode.

The second is by using the triangle fill facility. The instruction PLOT 85, X, Y fills in a triangle in the current graphics colour. The triangle is made up of the last two points accessed and the point X, Y. Thus a solid square, with its bottom left-hand corner at X, Y and sides of length S could be generated using the statements

```
MOVE X, Y
DRAW X, Y+S
PLOT 85, X+S, Y
PLOT 85, X+S, Y+S
```

Note that alternative PLOT instructions which use relative rather than absolute addressing could also be used (see PLOT 0, X, Y and PLOT 80, X, Y in the *User Guide*).

Triangle fill does not have to be confined to filling shapes whose boundaries are defined by straight lines. Thus a solid circle could be generated from a set of triangles with apexes at its centre.

The final method is the grass-fire technique which can fill any bounded area. The boundary may be viewed as a trench of cut grass. If we set fire to a point inside the boundary, this will set fire to its neighbours, and so on, until all grass within the boundary will be aflame – but the fire will be contained by the trench. Filling in can be achieved by a routine which, when given a point in a region, proceeds to colour in the neighbouring points until the boundary is reached.

Such an algorithm can be implemented by use of the POINT instruction. The function POINT (X,Y) returns the logical colour of

the pixel at X, Y. Thus, from a given point all the neighbours can be interrogated to see if the boundary has been reached, and where appropriate, neighbours can be filled in. Whenever a neighbour is filled in, its coordinates are stored in an array so that its neighbours can be checked in turn and filled if required.

Erasing and copying can be achieved using the grass-fire technique. The region is filled with the background colour, and as points are filled their coordinates are stored. These coordinates can then be used to redraw the object in its original position or in a new position. Operations such as rotating or shrinking the shape are then easy to achieve. The following code illustrates how the grass-fire technique could be used to erase a shape that contains the point X, Y.

```
  10 MODE 5
 100 ARRAYSIZE=200
 110 DIM X%(ARRAYSIZE),Y%(ARRAYSIZE)
 999 END
2000 DEFPROCERASE(X,Y)
2010 REM PROCEDURE TO ERASE THE SHAPE
2020 REM CONTAINING THE POINT X,Y
2030 REM AS POINTS ARE ERASED, THEIR
2040 REM COORDINATES ARE STORED IN
2050 REM ARRAYS X% AND Y%
2060 REM P1 IS A POINTER TO THE PIXEL
2070 REM WHOSE NEIGHBOURS ARE BEING
2080 REM EXAMINED. P2 IS A POINTER
2090 REM TO THE NEXT FREE ENTRY POINT
2100 REM IN THE ARRAY.
2110 ERRFLG=FALSE
2120 NPOINTS=1
2130 LOCAL P1,P2,XT,YT
2140 P1=1: P2=2
2150 X%(1)=X: Y%(1)=Y
2160 REPEAT
2170 FOR XT=X%(P1)-4 TO X%(P1)+4 STEP 4
2180 FOR YT=Y%(P1)-4 TO Y%(P1)+4 STEP 4
2190 IF POINT(XT,YT)=0 THEN GOTO 2260
2200 REM THIS NEIGHBOUR NEEDS FILLING IN
2210 REM AND ITS COORDINATES NEED TO BE
2220 REM STORED IN X%,Y%
2230 NPOINTS=NPOINTS+1
2240 PLOT 71,XT,YT
2250 X%(P2)=XT: Y%(P2)=YT
2260 P2=(P2+1) MOD ARRAYSIZE
2270 IF P2=P1 THEN ERRFLG=TRUE
2280 NEXT YT
2290 NEXT XT
2300 P1=(P1+1) MOD ARRAYSIZE
2310 UNTIL P2=P1
2320 ENDPROC
```

The algorithm can be modified to change a colour in a region, or to erase all points of a given colour in a region. When erasing, it is important that all eight neighbours of any point are tested. However, when filling in to a boundary only four neighbours (above, below, left and right) should be tested, otherwise it is possible that a diagonal boundary would not contain the process.

The grass-fire algorithm provides an additional piece of information when used to fill in a region, since the number of points filled is a measure of the area enclosed by the boundary.

The erase and copy facilities described earlier could be used with a menu of shapes drawn on the graphics screen. A user would be able to build up a drawing by making copies of these shapes at any point on the screen.

In any mode that allows the use of four colours, two bits are used to define each pixel. Instead of considering these two bits as representing a single colour, they can be regarded as representing a single midground colour and a single foreground colour.

Suppose the most significant bit in a pixel represents the midground, and the least significant bit the foreground. If in any given pixel, both midground and foreground colours are selected [pixel is set to 11 (binary)] then only the foreground colour is displayed. However, if the foreground colour is removed in that pixel (by setting the least significant bit to 0) then the midground colour would show. If the midground colour is now removed (by setting the most significant bit to 0) then the background colour would be displayed at that point.

If the background colour is to be black, the midground colour red and foreground colour green, the palette should be set up as follows:

Logical colour	*Actual colour*
0 (00)	Black
1 (01)	Green
2 (10)	Red
3 (11)	Green

It is now possible to access the midground or foreground independently of the other. To draw in the midground, it is necessary to set the most significant bit of the appropriate pixels. This can be done by ORing the number 2 with these pixels, and can be achieved by executing GCOL 1, 2 before drawing the shape.

In a similar way it is possible to draw in the foreground by ORing the number 1 with appropriate pixels. This can be achieved by executing GCOL 1, 1 before drawing the shape.

Foreground shapes can be deleted by ANDing 2 with appropriate pixels. This resets the least significant bit but leaves the most significant bit unchanged. Midground shapes can be deleted by ANDing 1 with appropriate pixels. Foreground shapes can be erased by executing GCOL 2,2 and redrawing the shape, and midground shapes can be erased by executing GCOL 2,1 before redrawing. As an illustration of the above, we will make use of the procedure PROCCIRCLE described earlier. If the palette is set up with

```
VDU 19, 0, 0, 0, 0, 0
VDU 19, 1, 2, 0, 0, 0
VDU 19, 2, 1, 0, 0, 0
VDU 19, 3, 2, 0, 0, 0
```

Then:

GCOL 1,1
PROCCIRCLE (500, 500, 150)
will draw a green circle of radius 150 at 500, 500 in the foreground.

GCOL 1,2
PROCCIRCLE (400, 400, 150)
will draw a red circle in the midground, and it will not be visible where it passes behind the green circle.

GCOL 2,2
PROCCIRCLE (500, 500, 150)
will then erase the foreground circle, revealing the remainder of the mid-ground red circle.

When using mode two, each pixel is represented by four bits. This could be regarded as four layers plus a background, where each layer can display one colour which covers all layers behind it. Alternatively, it could be treated as two layers plus background where each layer can display four colours. It is left to the reader to work out the details of how this could be implemented.

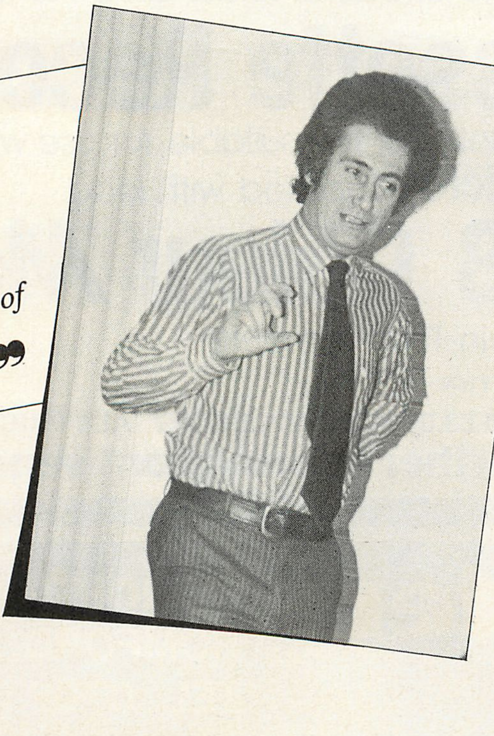
Further reading

Improving Image Generation and Structuring Using Raster Graphics, by S. A. R. Scrivener et al. *Proc. CAD 78*, Brighton, 1978.
Micro-based Interactive Raster Graphics, by L. A. Thomas and S. A. R. Scrivener. *MCI report 25*, Leicester Polytechnic, 1979.

The COMPUTER PROGRAMME and beyond

Future plans outlined by David Allen, Producer for BBC Television and Editor of the Computer Literacy Project

"the new series will be aimed more at owners of machines, or those about to take a serious plunge into the world of personal computing."



The Computer Literacy Project marches on

If you own a BBC microcomputer you will welcome news of a follow up to *The Computer Programme* which we're provisionally calling *Make the Most of the Micro*. (And if you missed the first series, there is the chance to see it on Sunday mornings, starting October 10th on BBC1.) The second series will be transmitted starting in January 1983. Whereas *The Computer Programme* provided a general introduction to computing, especially for those with no previous knowledge or experience, the new series will be aimed more at owners of machines, or those about to take a serious plunge into the world of personal computing.

As a result of several surveys we have a good deal of information about what these viewers would like to see in the new series. This is backed up by 80,000 postal enquiries.

Most people want information about how to use microcomputers, how to program them, how to get them to do useful jobs in business, education and the home.

Controversy reigns about the value of teaching programming, but there is growing evidence that, providing the nitty-gritty of 'coding' is seen as the last stage of a process of 'problem solving', *the* route to computer literacy is through 'hands-on' experience.

'Hands-on' Experience

Some of this may be through ready-made programs and some through do-it-yourself programming. The new series will consider both routes. And the fact that machines like the BBC microcomputer are capable of running in full colour, with high quality graphics and multichannel sound and even *speech*, the challenge to those who are prepared to learn to write programs is enormously rewarding, as we hope you've found for yourself.

The second series will show a range of machines being used for many purposes and will use the BBC microcomputer to explore basic principles. However, it will not be uncritical of micros – they do go wrong and people can expect too much of them. But tell that to the

severely handicapped post-graduate student who sent in an impeccably typed letter to us. It explained how he has used a microcomputer not only to run the word processor which produced the letter, but also to control seven mains relays (attached to fires, bells and TV) from a single button which he operates in the only way he can, using a rod attached to his head. He has written his own programs and they work. He is immeasurably more independent as a result.

So the next series will look into 'how to' in more detail and more critically than the earlier series. It's not possible yet to give detailed information about content but, as a rough guide, the areas covered are likely to be:

Programme 1 The Versatile Machine. We look at the coming of age of the micro, its versatility and the range of things a complete system can achieve. By looking at the complete BBC system we can get the idea (common to all computer systems) of input, output, processor and memory. We explore the nature of software and look at loading and saving programs using the simplest parts of the system.

Programme 2 Getting down to basics. Looks at the fundamentals of problem solving and, using a real life analogy, broken down into a flow diagram and then coded on the BBC machine, at a simple program which illustrates four of the six structures. We then see an application program being used in a primary school.

Programme 3 Strings and things. This programme continues the theme of fundamental structures of programming, including the idea of subroutines or procedures. It introduces string variables and the arbitrary but important ASCII coding which enables strings to be compared and may even allow characters to be defined by the user.

We look at how a long program is managed and at the importance of structure. The idea of the 'high level' language is introduced. This removes the need to code in BASIC and, therefore, opens up programming to more people, but it still requires the same kind of organisational skills. The use of a simple printer is introduced.



Chris Serle and Ian MacNaught-Davis in the current series.

Programme 4 Introducing graphics and sound. This considers some of the fundamental procedures involved in producing graphics, discusses the question of memory and how it is affected by the use of graphics. The idea of machine code is introduced and also the presentation of programs.

Programme 5 Data processing. This introduces the simplest ideas about data and data processing. It defines the concept of a database and of searching and sorting information. The difference between random access and sequential access to files is used to explain the need for disc drives.

Programme 6 Getting down to business. Having introduced the idea of data processing, we concentrate on the small business and the extent to which the micro can be used.

Programme 7 More on graphics. Here we explore non-keyboard input and non-screen output – especially in computer-aided design. We also look at speech synthesis and a recognition system.

Programmes 8 & 9 Communicating with the real world. These programmes look at analogue to digital conversion and the way micros can be used to monitor and control things. Hands-on sessions show how simple monitoring and control can be achieved.

Programme 10 New developments. Explores the micro's role in communications – networking, teletext and Prestel and, especially, telesoftware, and looks at where micros are going from now on.

Starting with an initial launch of eight packs this summer, BBC Publications intends to produce software to support the BBC machine. Among the first programs there will be two games packs, a home finance pack (in collaboration with the Consumers Association), two packs from the Royal College of Art (on 'painting' and 'drawing'), a music pack, an 'early learning' educational pack for youngsters and two packs in which programs from the first television series are drawn together.

With the exception of one of these last two programs, all will run on the model A (and all will run on model B). Further programs, including word processing, are in the pipeline.

The second series will be backed up by a range of new software and courses which will help you develop skills in particular areas of interest, such as control applications, music, speech, structured programming techniques and so forth. Details will be given in *Acorn User* later in the year.

In the next issue of Acorn User, David Allen will explain telesoftware and how the BBC aims to transmit programs on CEEFAX.

ACORN ANSWERS YOUR QUESTIONS ON THE B.B.C MICRO

What is the difference between the model A and model B?

The model B has 32k of RAM (16k on model A) and can thus support graphic modes zero to three, as well as modes four to seven available on the model A. These are configured as follows:

Mode 0	640 x 256	2 colours	80 x 32 text	(20k)
Mode 1	320 x 256	4 colours	40 x 32 text	(20k)
Mode 2	160 x 256	16 colours	20 x 32 text	(20k)
Mode 3			80 x 25 text	(16k)

The model B also has a number of additional interfaces:

- RS423 serial interface, compatible with RS 232 standard;
- 8-bit centronics – type parallel printer part;
- 8-bit users part (input/output links handshaking);
- 1 MHz buffered extension bus to standard Acorn crads and future expansion, e.g., Prestel, teletext;
- Four 12-bit analogue input channels, range 0-1.8 volts;
- sockets for colour and monochrome monitors;
- all expansion sockets supplied.

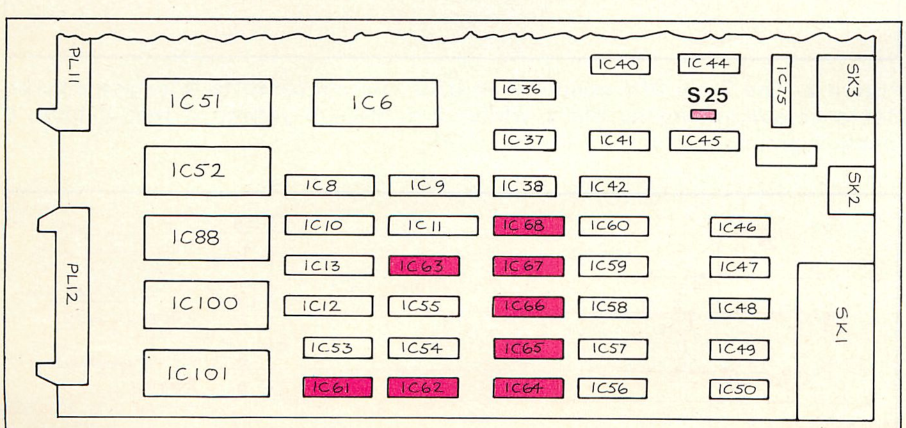


Figure 1. Part of Acorn's BBC computer mainboard assembly drawing shows position of link S25 and eight spare holders for new chips (shaded).

How can I upgrade a model A to model B?

This modification should be made by an authorised Acorn dealer. However, more experienced users can upgrade the memory to 32k by adding eight RAM chips of the type 4816 or 4516 (16k x 1) 100ns. These cost approximately £3.60 each (order code HM4816 AP-3).

First disconnect the power supply and remove the four screws labelled 'FIX' (two on base of machine, two at back). Then carefully take off the top cover to reveal the circuit board, the right half of which is shown in Figure 1.

The eight new chips must now be inserted into locations IC61 to IC68, facing the same direction as the other chips.

You then only need to change link S25 to connect the middle and far pin from the keyboard, rather than the middle and near pin. Carefully lift off the black pastic cover, and reposition over pins.

Replace the lid, taking care not to damage the three light indicators at the bottom left of the keyboard, and replace the FIX screws.

After this is successfully done, and the machine is turned on, the display will show:

BBC Computer 32k
BASIC

Converting the model A to take the extra interfaces is a far more difficult job. This should be left to your Acorn dealer, who can also upgrade the memory. Dealers should now be in a position to carry out the upgrades.



How do I connect a cassette recorder to the BBC machine?

The lead from the BBC micro can take several forms depending on the connections your cassette recorder has. The two most common are:

- 7 pin DIN to 5 pin DIN and 2.5mm jack (remote)
- 7 pin DIN to 2 x 3.5mm jack and 2.5mm jack (remote)

These leads are shown in Figures 2 and 3.

It is worth pointing out that a 5 pin DIN to 5 pin DIN or 3 pin DIN to 3 pin DIN will work, but will not offer remote control.

Most home cassette recorders will work but a specific machine is available from BBC Microcomputer System, 14 Station Road, Kettering, NN1S 7HE for £29.90 (inc VAT), Order code is ANFO3.

When will the Teletext adaptor be available?

Teletext units should be available in September. They cost £166.00 (inc VAT). There will also be a combined Prestel and Teletext unit whose price is not yet known. Note that it will not be possible to download software from an existing Teletext adaptor since this involves complex electrical modification. Details of software available via the Teletext and Prestel adaptors will be published by the BBC later this year.

What printers can I use with the BBC microcomputer?

The BBC computer can be used in its model B form to drive any parallel centronics – compatible printer using the 8-bit parallel printer port. Most readily available dot matrix printers use this method of interface or can be purchased with this option. Several printers may be attached through the RS423 port in conjunction with the 5-pin to 25 way 'D' connector (order code ANG 02). Acorn will be selling a cost-effective dot-matrix printer and a letter-quality 'daisy-wheel' printer, though the type and price of these is yet to be announced.

Can the Econet be used with the BBC microcomputer?

Yes, updated Econet software will be available for the BBC Econet next month. This will allow the Econet to be driven by a model B computer with discs as the file server, while other machines on the network may be of various types.

The BBC microcomputer, Acorn Systems and the Acorn Atom may all be intermixed on such an Econet system, though it is worth pointing out that screen copying will not work between machines of different types.

What is the hole on the left-hand side of the keyboard for?

The hole, usually covered by the keyboard template, allows access to the cartridge – ROM socket (not fitted as standard) which allows extra vocabularies to be added to the speech synthesiser, and cartridge software to be plugged in for quick loading into the machine. It is envisaged that as much software as possible will be available in cartridge form early next year.

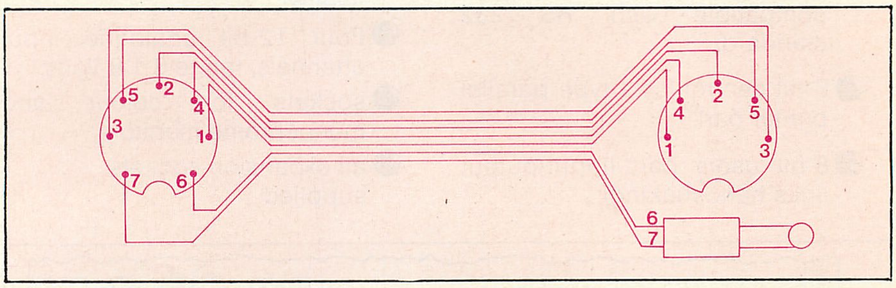


Figure 2. The 7-pin DIN connects to BBC micro's cassette interface socket. Cable colour coding is: pin 1 white; 2 screen; 3 yellow; 4 red; 5 blue; 6 black; 7 green.

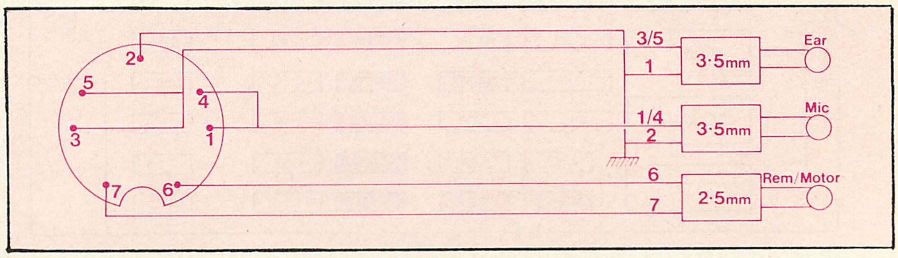


Figure 3. Pins 3 and 5, and 1 and 4 need not be connected together. However, if pin 3 is used pin 1 must be used. Same applies for pins 5 and 4. Colour coding as in Figure 2.

Official Acorn Dealers in the U.K.

Acorn dealers stock and service the Atom computer, Acorn Systems and Acornsoft software. Many also offer service facilities for the BBC micro and these are marked with an asterisk.

The Acorn dealer not only sells computers and peripherals but provides vital customer support. Most have recently attended technical seminars in Cambridge to ensure that they deal effectively with customers' enquiries. In addition, Acorn supply dealers with specific test and diagnostic equipment to speed fault finding.

LONDON
Barrie Electronics Ltd EC3
01-488 3316
Childrens World W8
01-937 6314
*Euro-Calc Ltd EC2
01-729 4555
*Euro-Calc Ltd W1
01-636 8161
*Euro-Calc Ltd WC1
01-405 3113
Future Tronic NW4
01-203 5161
*Group 70 E18
01-505 7724
*Micro Store SW3
01-352 9291
*Off Records SW11
01-223 7730
*Technomatic Ltd NW10
01-723 0233
The Video Palace W8
01-937 8587

BIRMINGHAM
Typewriter Centre (Erdington) B23
021-382 0185
Typewriter Centre (Head Office) B5
021-622 5385/7
Typewriter Centre (Dudley Road) B18
021-455 9111
Typewriter Centre (Kings Heath) B14
021-444 7349

AVON
*Microstyle Bath
0225-334659

BEDFORDSHIRE
*Broadway Electronics Ltd Bedford
0234-213639

BERKSHIRE
*Windsor Computer Centre Windsor
07535-58077

BUCKINGHAMSHIRE
*Tarace Ltd Wendover
0296-623915

CAMBRIDGESHIRE
*Arden Personal Computers Peterborough
0733-47767
*Cambridge Computer Store Cambridge
0223-65334
*Control Universal Cambridge
0223-358757

CHESHIRE
Bellard Electronics Ltd Upton
0244 380123
*Northern Computers Warrington
0928-35110

CLEVELAND
*Customised Electronics Ltd Middlesbrough
0642-247727

DERBYSHIRE
*Datron Micro Centre Derby
0332-380085

DEVON
*Bits & Bytes Ilfracombe
0271-62801

ESSEX
*Arden Business Systems Colchester
020-637 368
*Computers for All Romford
0708-60725
*Emprise Ltd Colchester
0206-865926
*J M Pickard Micro Computer Services Clacton on Sea
0255-29018

GLOUCESTERSHIRE
Computer Shack Ltd Cheltenham
0242 584343
*Independent Computer Consultants Tewkesbury
0684 298033

HAMPSHIRE
*Electronequip Porchester
0705-325 354
Hugh Symons Group of Companies Bournemouth
0202-23776
*R D S Electrical Portsmouth
0705-812478
*R M K Electronics Ltd New Milton
0425-616110
Typewriter Centre Bournemouth
0202-766997

HERTFORDSHIRE
*Compshop Ltd New Barnet
01-441 2922
*Computer Plus Watford
0923 33927
Intelligent Artefacts Ltd Royston
0223 207689
*Q-Tek Systems Ltd Stevenage
0438 65385

HUMBERSIDE
*Computer Facilities Scunthorpe
0724- 63167
*Vixon Computer Systems Cleethorpes
0472 58561

KENT
Abacus Micro Computers Ltd Tonbridge
089-283 3861
Kent Computers Herne Bay
02273-68900
*MD Wright Data Services Canterbury
0227-69090
*Protocol Computer Products Bromley
01-460 2580

LANCASHIRE
Merit Computers Ltd Wigan
0942-495821
Microrose Ltd Bentham
0468 62180
*NSC Computing Shops Ltd Manchester
061-832 2269

LEICESTERSHIRE
*D A Computers Leicester
0533-549407
*TB Computer Services Market Harborough
0536-770884

MERSEYSIDE
*Data Exchange Ltd Birkenhead
051-647 4213
*Liverpool Computer Centre Liverpool
051-236 2000

MIDDLESEX
*Microage Electronics Edgware
01-959 7119
*Twickenham Computer Centre Twickenham
01-891 1612

NORFOLK
*Anglia Computer Store Norwich
0603-29652

NORTHAMPTONSHIRE
M A Electrical Installations Irthlingborough
0933-650133

NOTTINGHAMSHIRE
*Leasalink Viewdata Ltd Nottingham
0602-396976

SHROPSHIRE
*Jentech Services Ltd. Bridgenorth
07462-5287

SOMERSET
*Somerset Business Computers Taunton
0823-52149
*The Computer Room Yeovil
0935-20268

STAFFORDSHIRE
Typewriter Centre Wolverhampton
90-27627

SUFFOLK
*Micro Management Ipswich
0473 59181

SURREY
*JS Simnett Computers Ltd Kingston-upon-Thames
01-546 3793
*P J Equipments Ltd Guildford
0483- 504801
*3D Computers Surbiton
01-337 4317

SUSSEX
*Castle Electronics Hastings
0424-437875
*Datex Micros Worthing
0903-39290
Gamer Brighton
0273-698424
*Microcentre Bognor Regis
0243 827779

TYNE & WEAR
*H C C S Gateshead
0632-821924
Newcastle Computer Services Newcastle-upon-Tyne
0632-761168

WEST MIDLANDS
H & H Business Systems West Bromwich
021-553 7606/7
Ibek Systems Coventry
0203-661162
Micrologic Ltd Halesowen
021-550 8036
*Taylor Wilson Systems Ltd Solihull
05645 6192
Typewriter Centre Coventry
0203-28799
Typewriter Centre Walsall
92-27589
Typewriter Centre Sutton Coldfield
021-355 6789
*Walters Computer Systems Ltd Stourbridge
03843-70811/2/3

YORKSHIRE
*Customised Electronics Ltd Leeds
0532-792332
*Datron Computers & Supplies Sheffield S10
0742-755105
*Datron Micro Centre Sheffield S7
0742-585490
*Eltec Services Ltd Bradford
0274-491371
Micro Power Leeds LS7
0532-683186
*Superior Systems Ltd Sheffield 1
0742-755005

WALES
*Cardiff Microcomputers Cardiff
0222-373072
*Cardigan Electronics Cardigan
0239-614483
*NE Wales Microprocessor Centre Flint
0244-816236

SCOTLAND
*Esco Computing Glasgow
041-427 5497
*Highland Microcomputers Forres
0309-73505
McQueen Systems Ltd Galashiels
0896-4866
*Personal Computers Ayr
0292-285082
Silicon Centre Edinburgh
031-332 5277

NORTHERN IRELAND
*C E M Microcomputer Services Belfast
0232-44111/43564

CHANNEL ISLANDS
*Channel Data Processing (Jersey) St Helier
0534-24333/72897

ISLE OF MAN
*Typestyle Ltd Onchan
0624-25890/24650

MACHINE CODE GRAPHICS

by John Shaw and Anthony Ferguson of MEDC, Paisley College

The quality and flexibility of display modes on the BBC micro is met by disbelief in those first introduced to the machine. Eight graphics modes ranging from 40 x 25 to 640 x 256 resolution with up to eight colours and an 80-column text format make this the most versatile low-cost micro yet. A range of BASIC commands provide all the power needed to obtain fast, animated colour graphics with relative simplicity.

A feature not so obvious is the ease with which all these functions can be driven from an assembly language program. This follows from the design of the BBC's display software which is 'code driven' and aimed at an intended future role of the machine – namely a sophisticated graphics terminal to a second language processor, 6502, Z80 or a 16-bit option, with its own memory.

Figure 1

```
100 MODE 5
110 FOR colour=0 TO 15
120 GCOL 0,colour
130 PLOT 4,0,0
140  FOR J=1 TO 128
150 PLOT 1,1280,4
160 PLOT 1,-1280,4
170 NEXT J
180 NEXT colour
```

Figure 2

```
100REM assembly language graphics
110REM commands - home cursor
120MODE 5
130OSASCI = &FFE3
140DIM A 100
150FOR PASS=0 TO 3 STEP 3
160P%=A
170REM subroutine to home cursor
180REM equivalent to PLOT 4,0,0
190[OPT PASS
200.HOMEC LDA #25
210JSR OSASCI
220LDA #4
230JSR OSASCI
240LDA #0
250JSR OSASCI
260LDA #0
270JSR OSASCI
280LDA #0
290JSR OSASCI
300LDA #0
310JSR OSASCI
320RTS
330]
340NEXT PASS
350CLG
360END
```

The machine uses the ASCII code system where each letter of the alphabet or special character is given a numeric value (see code listing on page 27). In BASIC, the PRINT statement sends these ASCII codes for the chosen message to a machine code display routine in the operating system (OSASCI or OSWRCH).

The display routine will handle all the 'housekeeping' functions required by the display, e.g.:

- place the character in the next available screen memory location;
- take a new line if required;
- scroll the screen if required.

The BASIC statement CHR$ allows us to state the ASCII code of the character to be printed. Hence:

PRINT CHR$ (65);CHR$(66)

would give the same result as

PRINT "AB"

The BBC micro has a useful feature where PRINT and CHR$ functions can be combined into the single BASIC statement VDU. Hence

VDU 65,66

would again send ASCII 65 followed by ASCII 66 to the display routine, and then to the screen.

Performing the same task from assembly language involves loading the accumulator with the ASCII code and then calling the display routine. (This can not be typed in as shown – read on.)

```
LDA #65\ASCII 'A' into ACC
JSR DISPLAY\to DISPLAY
LDA #66\ASCII 'B' into ACC
JSR DISPLAY\to DISPLAY
```

Examination of the ASCII code table shows that not all the 256 possible codes are required to represent the alphanumeric character set. Extra codes between 0 and 31, often called control codes, are given the special job of organising the display and driving the graphics on the BBC machine. Hence all the BASIC keywords used to control the display have their equivalent VDU statement, e.g.:

PRINT "A"	VDU 65	LDA #65 JSR DISPLAY
MODE 5	VDU 22,5	LDA #22 JSR DISPLAY LDA #5 JSR DISPLAY
COLOUR 3	VDU 17,3	LDA #17 JSR DISPLAY LDA#3 JSR DISPLAY

The first code after the VDU statement, i.e. the first byte sent to the display routine, selects the desired display function. The operating system then knows how many more bytes are required to complete the instruction, e.g. MODE selection only requires one byte after the code, whereas redefining the shape of a display character would require nine.

A call to a subroutine to display the character in the accumulator on the screen is easily achieved. Within the BBC machine operating system there are two subroutines that will perform this function:

OSWRCH	located at	&FFEE
OSASCI	located at	&FFE3

The difference between the two routines is that OSASCI will also generate a line feed when a carriage return code (&0D) is received whereas OSWRCH will not.

In the assembly program examples, OSASCI is used as the display subroutine to be called whenever characters are sent.

The BASIC program in Figure 1 when run will draw a continuous zig-zag line from the bottom to the top of the screen in a succession of graphics foreground colours (0-15). The effect of this is to make the screen change colour in a sweep from bottom to top.

The GCOL command sets the colour to be used by subsequent graphics commands. The zero value of the first parameter specifies that the colour corresponding to the value of the second parameter is to be plotted. Thus GCOL 0,1 produces a graphics

foreground colour of red.

PLOT 4,0,0 moves the graphics to position (0,0) on the graphics area.

PLOT 1,1280,4 draws a line relative to the current graphics cursor position in the current graphics colour. For example, if the current position is (0,0) the line will be drawn from (0,0) to ((0+1280),(0+4)) i.e. (1280,4) or four units up at the right-hand side of the screen. Similarly the next command, PLOT 1,-1280,4 draws from the current position e.g. (1280,4) to the left-hand side of the screen ((1280-1280),(4+4)) i.e. (0,8).

Graphics commands such as those used in Figure 1 (left) can also be generated from within an assembly language program by using the VDU drivers of the resident machine operating system. The technique employed is the same as that described earlier – that is, each successive byte of the appropriate VDU command, including the VDU command number, is sent to the routines of the machine operating system by placing each byte in the accummulator and then calling subroutine OSASCI (JSR &FFE3) – the display routine.

For example, line 130 of the BASIC program homes the graphics cursor to (0,0) – bottom left of the screen. This can be done, as in the BASIC program, with the command

PLOT 4,0,0

Equally we might use the VDU command

VDU 25,4,0,0,0,0,

to achieve exactly the same effect. The first number, 25, is the VDU command which tells the machine operating system that what follows will be the parameters of a PLOT command. The first of these parameters in this example is a 4, which in the PLOT command means 'move to absolute position'. The next pair of numbers (0,0) provide the *x* co-ordinate position to move to. The first of this *x* pair is the low-byte part of the number and the second the high-byte part. For example, if an *x* co-ordinate value of 64 was required, the pair of numbers to be supplied would be 64,0 – in that order.

For example, to move absolutely to position 64,0 on the screen, the VDU command would be VDU 25,4,64,0,0,0. The final pair of parameters provide the low-byte high-byte value of the *y* co-ordinate.

An assembly language program can now be written to send this VDU command information directly to the machine operating system rather than via the BASIC interpreter.

Moving absolutely to position 0,0 is equivalent to homing the cursor, and the assembly language program in Figure 2 shows how this might be done. (Two passes of the assembler are not actually required for the assembly of this program).

To run the machine code program generated by the previous BASIC/Assembly language program all that is required is the machine code call command

CALL HOMEC

and the graphics cursor will be homed to 0,0 (bottom left).

To prove this, enter the following sequence of instructions while in MODE 5.

MOVE 700,700	move graphics cursor away from 0,0
DRAW 1000,1000	illustrate position of cursor
CALL HOMEC	call machine code home-cursor routine
DRAW 500,1000	prove above command worked

In a similar way the entire BASIC program can be translated to a series of VDU commands that can be written as an assembly language program and later executed directly as a machine code program. A listing of a program to perform exactly the same function as the original BASIC program (Figure 1) but without the involvement of the BASIC interpreter is given in Figure 3.

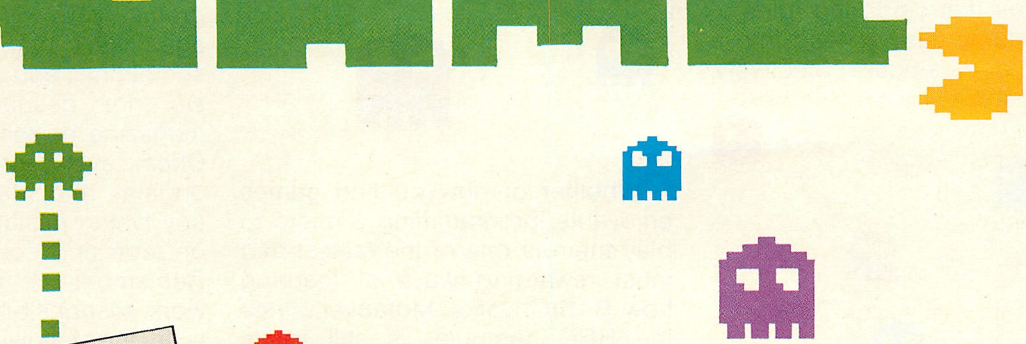
This program has been written in a way that tries to show the equivalence of the two programs in producing the same effect but using quite different ways of accessing the VDU drivers.

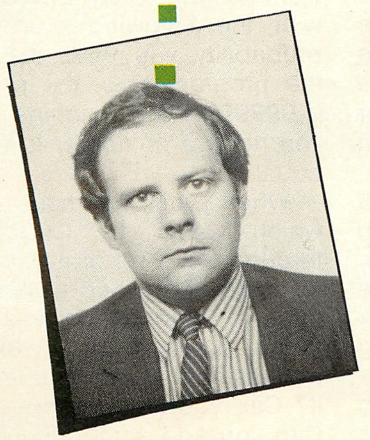
Figure 3

```
 10 REM generating graphics from an
 20 REM assembly language program
 30 MODE5
 40 OSASCI = &FFE3
 50 DIM A 150
 60 FOR PASS=0 TO 3 STEP 3
 70 P%=A
100 [OPT PASS
110 .MAIN  LDX #0     ;X reg holds colour
120 .NCOL  JSR COLR   ;change colour
130        JSR HOMEC  ;home cursor
140        LDY #128   ;set line count
150 .NLIN  JSR DLIN   ;draw pair lines
160        DEY        ;dec line count
170        BNE NLIN   ;next lines?
180        INX        ;inc colour count
190        CPX #16    ;all colours yet?
200        BNE NCOL   ;next colour or
210        RTS        ;return to BASIC
220 ]
230 REM subroutine to home cursor
240 REM equivalent to PLOT 4,0,0
250 [OPT PASS
260 .HOMEC LDA #25
270        JSR OSASCI
280        LDA #4
290        JSR OSASCI
300        LDA #0
310        JSR OSASCI
320        LDA #0
330        JSR OSASCI
340        LDA #0
350        JSR OSASCI
360        LDA #0
370        JSR OSASCI
380        RTS
390 ]
400 REM subroutine to change colour
410 REM equivalent to VDU 18,0,colour
420 [OPT PASS
430 .COLR  LDA #18
440        JSR OSASCI
450        LDA #0
460        JSR OSASCI
470        TXA
480        JSR OSASCI
490        RTS
500 ]
510 REM subroutine to draw line across
520 REM and back, equivalent to
530 REM VDU 25,1,1280;16;
540 REM VDU 25,1,-1280;16;
550 [OPT PASS
560 .DLIN  LDA #25
570        JSR OSASCI
580        LDA #1
590        JSR OSASCI
600        LDA #0
610        JSR OSASCI
620        LDA #5
630        JSR OSASCI
640        LDA #4
650        JSR OSASCI
660        LDA #0
670        JSR OSASCI
680        LDA #25
690        JSR OSASCI
700        LDA #1
710        JSR OSASCI
720        LDA #0
730        JSR OSASCI
740        LDA #&FB
750        JSR OSASCI
760        LDA #4
770        JSR OSASCI
780        LDA #0
790        JSR OSASCI
800        RTS
810 ]
820 NEXT PASS
830 CLG
840 END
```

When the program has been assembled and the machine code run using a CALL MAIN, the same effect will be seen on the screen as was produced by the original BASIC program. Perhaps surprisingly, very little increase in the speed of execution is obtained – a machine code program will only produce considerably faster graphics if its 'equivalent' BASIC program is slowed down by the work of calculations etc., and in our example this was not the case.

THE NAME OF THE GAME



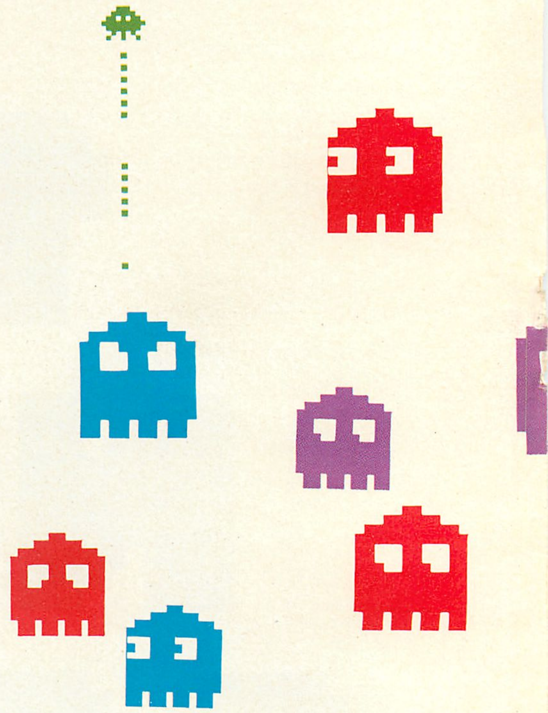


Simon Dally, a games enthusiast and 'home computer' addict, sets you thinking about games and launches a major competition. *Acorn User* will present a regular 'brainteaser', so read on for some inspiration, and then turn *your* power on and exercise that keyboard.

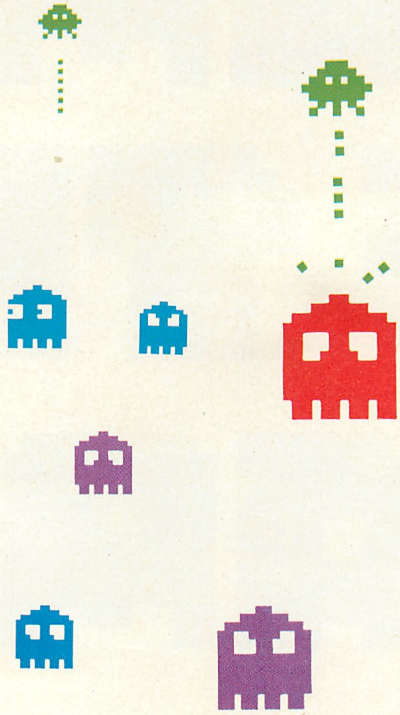
From the moment you unpack that eagerly-awaited microcomputer you will find yourself enmeshed in a many-stranded net of games. There are good reasons for this. First, there is the novelty value – few of us can resist a challenge from an inanimate object which apparently has a mind of its own. Second, the number and variety of games is staggering – just leaf through the adverts from software houses in any home computing magazine. And third, collecting games programs is probably the fastest means of acquiring a software library.

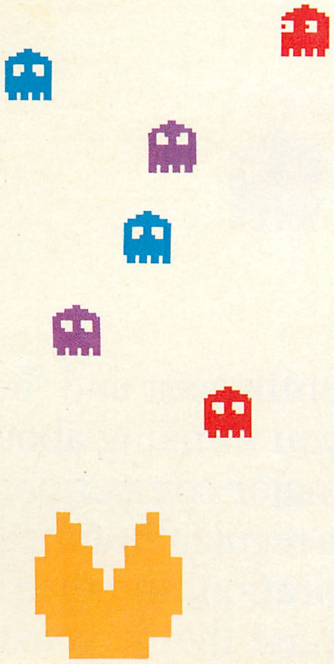
You may have justified the initial expenditure on the grounds that a micro was going to help with your home finance problems or catalogue your stamp collection, but all the same, it's useful to have some classy-looking software up your sleeve (or rather, your random access memory) to impress friends, both sceptical and admiring, who ask, 'But *what else* can it do?'

A taste for playing games is not restricted to microcomputer enthusiasts. Wargames, adventure games and chess programs have long been occupying the memory cells of vast mainframe computers. Chess occupies a special niche because of its relationship to artificial intelligence. One widely-held theory holds that since the rules of chess are fairly easy to feed into a computer and since, objectively, there must always be a 'best move', it should be possible to construct a computer program which cannot be beaten by a human being – just as computers (programmed correctly) are unbeatable at draughts or noughts and crosses.



In practice, despite enormous advances made in recent years, it remains staggeringly difficult to program computers to make reasonable moves within a reasonable time. Opinion differs as to whether it will take five years, 10 or forever before the world chess championship is won by a computer, so maybe there's hope for us humanoids yet!





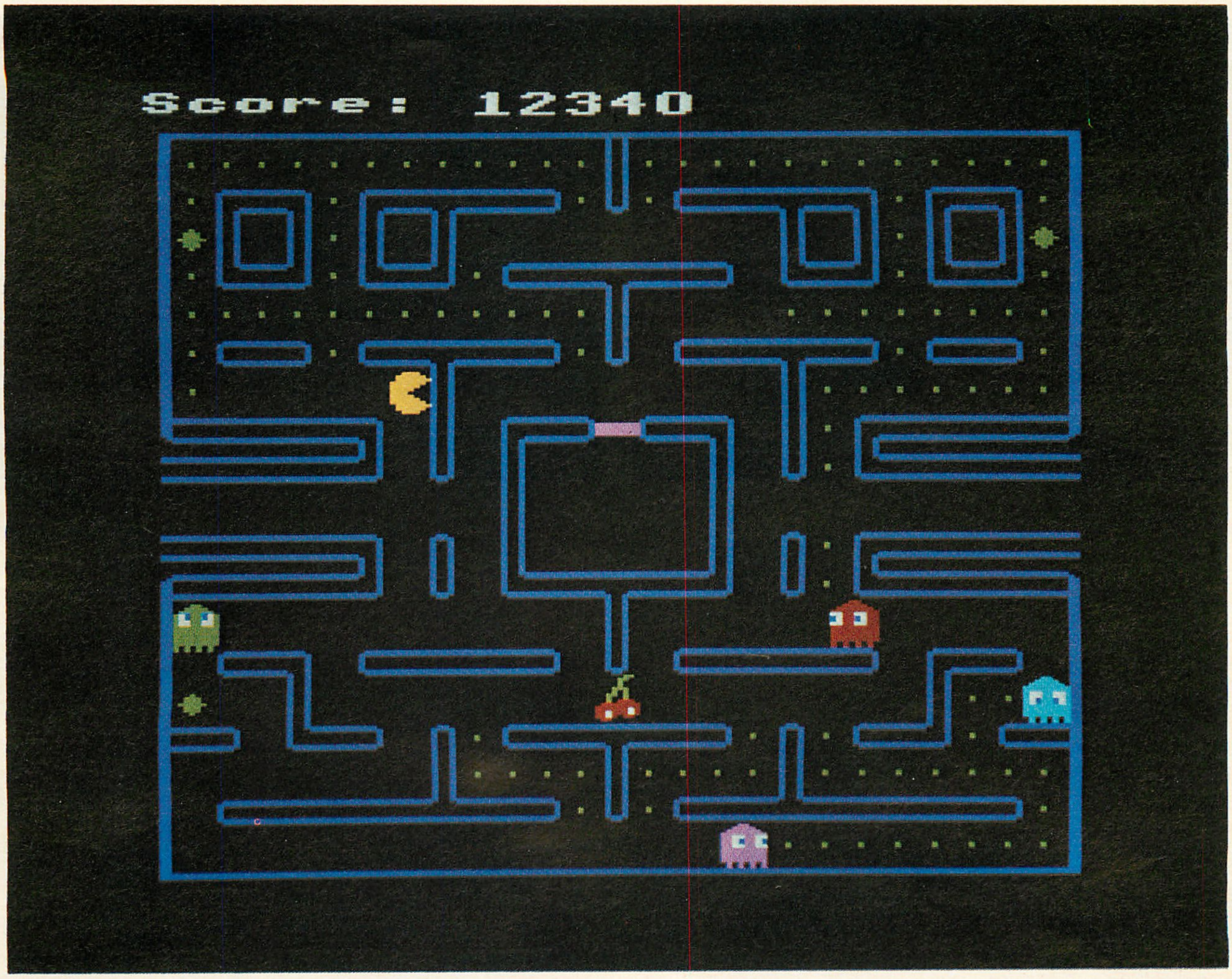
Whether or not you find games enjoyable, programming a micro to play them is one of the fastest and most rewarding ways of learning how BASIC works. Moreover, since the BBC computer is still in its infancy, there isn't much software available off the shelf – all the more reason to get down to writing your own programs and dumping them on tape!

There is an enormous number of published games programs in books and magazines, and programs written specifically for the BBC micro are beginning to appear in magazines. The following tips are based on my own experience as a complete novice with home computers some two years ago.

Start by typing in some of the shorter programs written in BBC BASIC which are appearing, regardless of what they are supposed to do. Don't worry too much if eccentric-looking words like MID$, LEN, EVAL, or DEF PROC aren't clear yet – they will be, sooner or later.

Often, when you run these programs, you will encounter messages like 'syntax error', 'mistake' –or something equally disagreeable. Do not despair, tear up your magazine or assault your machine. Check every line carefully with the original, and if you still can't spot any typing mistakes, save the thing on tape and come back to it later. Remember, if the thing doesn't work, responsibility for the error lies with the following – in order of probability: you (95%), the author of the program (3%), the proofreader (1.99999%), the machine . . . well, you need a computer to make that equal 100!

When you do have a game which works, try to look at it through the eyes of a critic instead of those of a proud owner. Do you think you understand how it works? Is the presentation on the screen professional or can you improve on it? Can you make it more difficult? Can you add some amusing visual or graphic effects? . . . 22▶

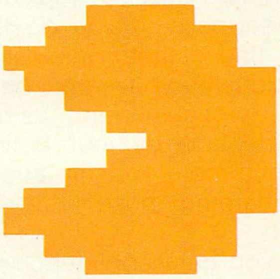


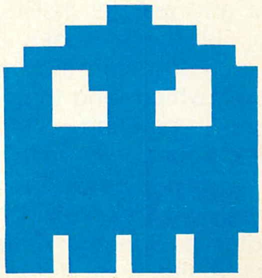
Snapper puts you into the hottest part of the video jungle, where the law is: eat or be eaten! Your food is fruit – but beware, ghosts are lurking to gobble you up, and you can't get them until you've found a power pill and entered 'devour mode'.

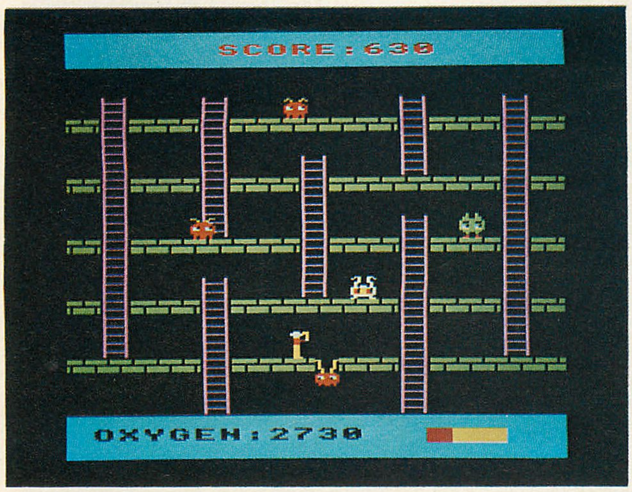
The more you eat and the longer you stay alive, the more points you collect until, after 12 screenfulls, you reach the ultimate food – an acorn worth 5000 points.

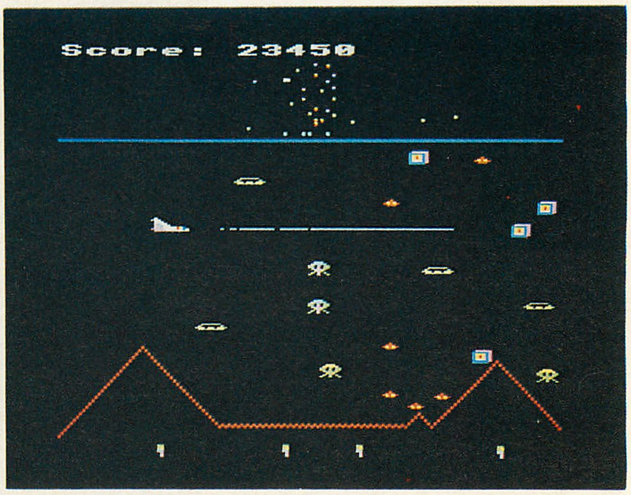
A total of 1000 is the minimum to rank among the top eight players on the high score table – but the highest known score is 100,560!

Snapper is the Acornsoft version of Pac Man – reported to be the hottest game to land since Space Invaders. It comes in eight colours, complete with sound effects in BBC micro mode two. So far it can only be played on the B machine, or an upgraded A. It costs £9.95 including VAT, uses four keys on the micro and comes with full instructions. Available from Acornsoft, 4a Market Hill, Cambridge CB2 3NJ.









MONSTER

This game will drive you up the wall! The mean Monsters are everywhere and are out to get your man. They chase him up and down ladders and along underground passages. Digging holes to ambush the meanies is your only hope.

You score by trapping and burying the Monsters. But here's a tip – the further they fall, the more points you get. So plan carefully and try to drop them down as many levels as possible. But watch out – you only have a limited oxygen supply, and as the game draws to a close your man becomes slower, turns blue and eventually passes out.

DEFENDER

Battle stations . . . mutants attacking . . . launch Defender. Steer your ship through the swarming attackers and shoot down the invaders before they can destroy your race and planet.

But the task is far from easy. The aliens can match your firepower – and they come thick and fast. Hyperspace is your final escape, but not for long. You will need all the cunning of the Klingons, the resources of Buck Rogers and the logic of Spock to survive.

Both these games are available for your model A from Acornsoft at £9.95. For address see previous page, or your local dealer.

Experiment by adjusting any line which puzzles you and see what happens. If you do this you will find that almost subconsciously you are becoming more proficient in using the machine, hour by hour. Believe me, it's much more exciting (and easier) than learning those first words of French.

As you gain confidence you will increasingly want to write programs – and improve your understanding of BASIC. If you like games and puzzles take a look at Martin Gardner's books (all available in Penguin): they're full of problems which lend themselves to computer solution. 'Intellectual' puzzles appear in many periodicals. I will never forget the pleasure of first solving on my computer a *Sunday Times* Brainteaser. In the time it took, me to work out the program I could have solved it without a computer – but that's not the point. There is nothing to beat your own 'hands-on' experience – so get to it!

Finally, do not think that writing games programs is a sterile pastime. People who write good games can earn money selling them. And one day someone is going to make a fortune with a program which plays a good game of bridge.

Here are two problems for you and your computer. The authors of the ten best programs to solve them on a BBC micro win a year's free subscription to *Acorn User*.

The first is to write a program to simulate the throwing of dice in the popular Waddington's game of *Risk*. In this game the attacker throws three dice, the defender two. The attacker's best two dice are compared with those of the defender. Where the defender's die is equal to or greater than the attacker's, the attacker loses an army; where the defender is weaker, it's his army which goes.

Attacker dice throw	Defender dice throw	Result
6,4,4	6,4	Attacker loses 2
6,4,4	6,3	Both lose 1
6,4,4	5,3	Defender loses 2

Give each side 100 armies to start with and keep a running total as the battle progresses: which side has the advantage?

The second is to make the computer deal a standard pack of 52 playing cards into four hands. But it's not good enough to have the 12 of hearts of card number 28. How pleasant can you make those graphics? How about some sound effects as each card is dealt?

Send your listing by August 1 to: The Editor, *Acorn User*, 53 Bedford Square, London WC1B 3DZ.

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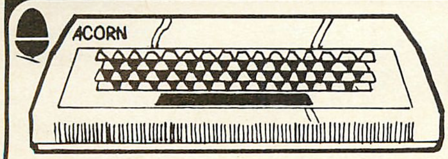
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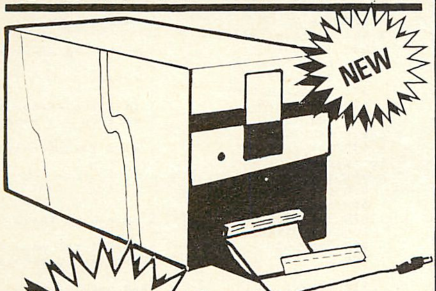
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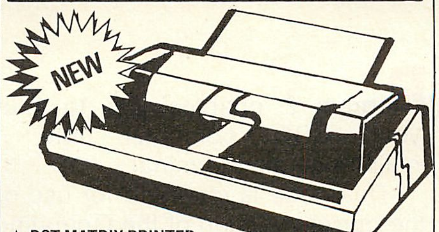
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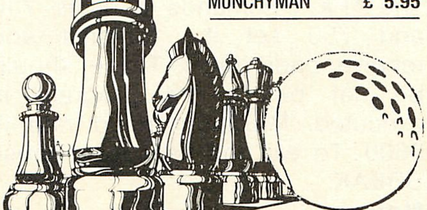


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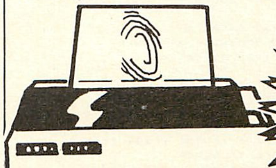
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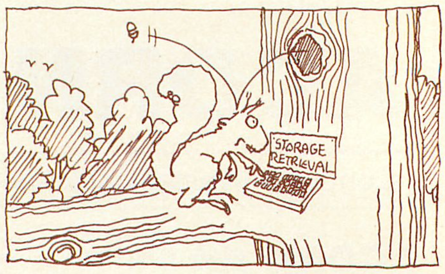


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Looking at Listings



Sometimes it is useful to be able to feed a program into a computer via the Serial Interface instead of typing it in at the keyboard. For example, you can connect two different computers together and use this technique to transfer a program from one to another. To do this both computers must have an RS232 or RS423 interface.

Program 1 enables the BBC micro to load from RS423 instead of the keyboard. This is achieved by storing a small assembly routine at location &0D00 which inputs characters from the RS423 port. Function key 9 is then used to change the OSRDCH vector which redirects the input stream from the keyboard to the RS423. Once the program has been RUN, it is advisable to type NEW before key 9 is pressed. This clears the existing program ready for the new one. To regain control of the keyboard the user must press BREAK. The new program is then retrieved by typing OLD. Subsequent pressing of function key 9 will cause input from RS423 again.

Program 2 enables you to plug your BBC computer into a mainframe as a terminal.

This code is intended for use on the current version of the Operating System, Issue 0.10. The program makes the BBC micro behave as a dumb terminal. The system is initialised in BASIC but the main part of the program is written in assembler so that it is able to run fast. Communications are via the RS423 connector with full handshaking. The *FX commands at lines 730 and 750 set the transmit and receive baud rates. These should be set before the program is executed. Maximum baud rate is 9600. To exit the user must press BREAK.

Note:
This program will not run correctly when the tube is connected.

Program 1

```
140 REM PROGRAM LOADER.
150 REM R.C.RAND ACORN COMPUTERS (C) APRIL 1982
160 REM
170 *KEY 9 ?&0210=&00: ?&0211=&0D |L |M
180 REM on execution of key 9 reassign the
185 REM OSRDCH vector to obtain characters from
190 REM the subroutine at &0D00
200 *FX 7,4
210 REM Set recieve baud rate to
220 P%=&0D00          :REM assemble at &0D00
230 [                 \go into assembler
240 .LOOP
250 LDA #&01          \load immediate 1
260 BIT &FE08         \test if bit0 of RS423
265                   \status register is set
270                   \this checks if data is ready
280 BEQ LOOP          \if data is not ready then
285                   \check it again
290 LDA &FE09         \load the data from RS423
295                   \data register
300 RTS               \return from subrouti
310 ]                 :REM leave assembler
320 END
```

Program 2

```
  150 REM  TERMINAL
  160 REM  R.C.RAND  ACORN COMPUTERS (C) April 19
82
  170 REM
  180 PRINT"Please input one of the following :"
  190 PRINT"  S  for <Simplex>  or  D  for <Duple
x> "
  200 INPUT mode$
  210 IF mode$ = "S" THEN simplex = 1 ELSE simple
x = 0
  220 FOR X=0 TO 3 STEP 3  :REM do two passes thr
ough assembly code
  230 P%=&0D00             :REM set program count
er to start of code
  240 STATUS=&FE08         :REM set address of RS
423 status register
  250 RS423=&FE09          :REM set address of RS
423 data register
  260 OSASCI=&FFE3         :REM address of Operat
ing System subroutine
  270 OSBYTE=&FFF4         :REM address of Operat
ing System subroutine
  280 OSWRCH=&FFEE         :REM address of Operat
ing System subroutine
  290 [                    \ go into assembler

  300 OPT X                \ set assembler option
 to 0 then 3
  310 .LOOP                \ main loop

  320 LDA #&01             \ load immediate 1
  330 BIT STATUS           \ test if bit0 is set;
 to see if data ready
  340 BEQ getkey           \ if data not ready th
en go look at keyboard
  350 LDA RS423            \ else load data
  360 PHA                  \ save the data on the
 stack
  370 LDA #&03             \ load 3
  380 JSR OSWRCH           \ disable RS423;  used
 with accumulator=3
  390 PLA                  \ retreive data from s
tack
  400 JSR OSASCI           \ write ASCII characte
r to screen
  410 LDA #&02
  420 JSR OSWRCH           \ enable RS423;  used
with acc=2
  430 JMP LOOP             \ see if RS423 has ano
ther char ready
  440 .getkey
  450 LDA #&81             \ equivalent to INKEY(
0)
  460 LDX #00              \ with zero delay
  470 LDY #00
  480 JSR OSBYTE
  490 TYA                  \ move Y to A to be te
sted
  500 CMP #&00             \ does Y = 0
  510 BNE invalidchar      \ if Y is not = 0 then
 the char is invalid
  520 LDA #simplex         \ is screen echo requi
red
  530 BNE duplex           \ if yes then branch t
o duplex
  540 LDA #&01
  550 JSR OSWRCH           \ disable screen

  560 .duplex
  570 TXA                  \ char is returned in
X but is required in A
  580 JSR OSASCI           \ write the ASCII char
 in A to screen and/or RS423
  590 JMP LOOP             \ repeat
  600 .invalidchar
  610 CMP #&FF             \ is Y the escape char
  620 BEQ LOOP             \ if Y is not escape r
epeat the loop
  630 LDA #&7E             \ else re-initialise t
he system
  640 LDX #00
  650 LDY #00
  660 JSR OSBYTE
  670 LDA #&02             \ re-enable RS423
  680 JSR OSWRCH
  690 JMP LOOP             \ repeat the main loop
  700 ]                    :REM leave assembler

  710 NEXT X               :REM used to sweep thr
ough the assembler twice
  720 CLS                  :REM clear the screen

  730 *FX 8,4
  740                       REM set transmit baud
 rate to 1200
  750 *FX 7,4
  760                       REM set recieve baud
rate to 1200
  770 *FX 5,2
  780                       REM select RS423

  790 VDU 2                :REM enable RS423
  800 CALL &0D00           :REM call the assemble
d code at location &0D00
```

So you want to beat a bug and draw an alien...



Joe Telford, of the Cleveland Educational Computing Centre, gives you the lowdown on some crafty tricks to squeeze the best out of your BBC micro. This month he covers programming, debugging and graphics.

Possibly the most useful feature to aid programming on the BBC micro is the ability to select a particular screen size using modes zero to seven. I prefer to run programs on a colour monitor, but a monochrome monitor provides a crisper screen for text entry. Whenever possible I use mode three for programming, as it allows a large amount of text to be visible at one time.

My colour monitor works well with text in all modes except three and zero. This is because a text character in these modes is built up from dots which are smaller than the dots of the monitor's shadow mask. The result is that the 80 character width has less crisp definition than other modes. On a monochrome monitor, there is no shadow mask so the characters can be crisply presented.

When using the colour monitor during text entry, (usually in debugging a colour graphics program), I tend to work in mode seven (teletext mode) because of the crisp text it allows. Despite the availability of modes two and five, I prefer not to use them during text entry, because of the reduced number of characters per line, and the difficulty in reading lines which spill over the screen width (called wraparound).

Despite these shortcomings of conventional colour monitors, I find that for running programs with coloured graphics, these colour monitors – and good quality colour television sets – can provide a stunning picture.

Program 1 demonstrates all the foreground/background combinations with text. On a colour monitor, merging of text in modes zero and three is particularly apparent in letters like w, n, m. In running the program, the computer will cycle through all modes apart from mode seven and present combinations of coloured backgrounds with coloured foreground text. To examine a particular combination simply press any key.

To continue, press another key. In the listing, lines 120 and 190 perform the freeze/unfreeze functions, respectively.

One problem which arose was stopping a program run in any mode, but still having an uncluttered screen to start editing from. My initial solution was very simple: press BREAK – this gives a clear screen in mode seven but loses the program. Then type OLD and press RETURN – this retrieves the program and editing can continue.

This is acceptable provided you wish to edit in mode seven. However, another solution would be to include at an early line number a program line which traps an error and clears the screen, returns to the editing mode which you have chosen, then reports on the error. This sets up the display for uncluttered editing. Look at the listing of Program 1. The error trap has been left in place deliberately, and although no errors exist, a press of the ESCAPE key during a run will be regarded as an error,

Program 1

```
   10 ON ERROR GOTO 160
   20 *FX 11,0
   30  FOR mode=0 TO 6
   40 MODE mode
   50 FOR X=0 TO 15
   60 FOR Y=0 TO 15
   70 VDU 19,128,X,0,0,0: COLOUR 128
   80 CLS
   90 VDU 19,1,Y,0,0,0: COLOUR 1
  100 PRINT '' "MODE ";mode; " FOREGROUND ";Y;" B
ACKGROUND ";Y+128
  110 FOR Z=1 TO 12:PRINT"The quick brown fox jum
ped over the lazy dog.";:NEXT
  120 IF INKEY$(20) <> "" THEN PROC_WAIT
  130 NEXT:NEXT
  140 MODE7: PRINT '' "DONE"
  150 GOTO 170
  160 MODE7: P> ''' "MODE ";mode;" FOREGROUND ";Y
;" BACKGROUND ";Y+128 '' :*fx 11,50
  170 REPORT: PRINT " at "; ERL
  180 END
  190 DEF PROC_WAIT
  200 Z=GET
  210 ENDPROC
```

and the screen will be set up to edit. The error trapping is turned on by line 10 which directs the program execution to lines 160 and 170 if an error is found. Here the program provides the required mode, screen clear, and information to help correct the error.

Note that the words REPORT and ERL are explained in the *User Guide.* The apostrophe (') is used to produce the same effect as a RETURN, but within a PRINT line. Another valuable feature is the colon (:) which allows multiple statements on a line. For example the statement group at line 110 in Program 1 is useful to have on one line.

During program entry the AUTO function means time can be saved by letting the computer produce line numbers. In programs where a number of keywords are used regularly it is worth defining them on the function keys. Three regular keywords are defined below:

```
*KEY  0   DATA
*KEY  1   DEFPROC
*KEY  2   ENDPROC¦M
```

It is important to label the function keys for their purpose. Touching function key 0 will produce the word DATA and allow typing to continue on that line. The function key 1 will perform the same operation with the word DEFPROC. The last key defined not only produces ENDPROC, but moves onto the next line, because the code for a RETURN is included in the definition ¦ M. Complete program lines can be entered into the function keys, as can multiple statement lines. One I use regularly is:

```
*KEY   9   G = INKEY (500)¦M
```

so that whenever I type function key 9 I generate a program line which will give me a five second delay within the program.

One well thought out facility on the BBC microcomputer is the auto repeat on all keys. This manifests itself in two parts. First, the delay before repeat, which is set to 0.5 second and, second the repeat rate which is set to 0.07 second per character. Both these parameters can be altered by operating system calls. The delay before repeat is controlled by *FX 11, N where N is a number from 0 to 255, and is measured in hundredths of seconds. The comma may be replaced by a space. *FX 11, 100 will give a delay of one second. *FX 11, 20 is useful for adept users, and *FX 11, 50 will reset the delay to its original value.

During program runs *FX 11, 0 will turn off the repeat facility so novices who rest fingers on keys will not find themselves generating long lines of characters. In program 1, line 20 protects against the repeat function, while line 180 restores it.

There is also value in varying the rate of repetition. This is done with the command *FX 12, N where N is the repeat speed from 0 to 255, in hundredths of seconds. Again the comma could be a space. Beginners to the copying function could find that *FX 12, 15 is a more relaxed speed for copying lines. Adepts could find that *FX 12, 5 is useful, and for copying large blocks of text *FX 12, 2 zips along lines. Resetting the repeat rate can be done with the command *FX 12, 7 or *FX 12, 0.

During the run of a program with graphics, it is useful (especially during games) to be able to alter the direction of shapes moving on the screen. Unfortunately, the cursor keys which have arrowed directions on them are not normally accessible from the INKEY function. To make them available, we can make use of the program line *FX 4, 1. They then return their ASCII code, just like any other key. *FX 4, 0 makes them available once more for editing.

By way of concluding this section, I will leave it to the reader to discover what happens on typing REPORT: *FX 0 after pressing BREAK.

Graphics

There are three different types of graphics on the BBC microcomputer: high resolution; user-defined; and teletext.

Unfortunately, as we move down the list, the information available from the provisional *User Guide* decreases, and the need to know increases. Although high resolution provides the means to create diagrams or pictures, the speed of creation in BASIC is such that movement is very jerky. The result is that for most games, high-resolution graphics would be used to form the background for moving user-defined graphics.

Features available in high-resolution modes include plotting points, drawing lines, and filling triangles, and we are led to expect curve-drawing routines in later issues of the operating system.

For those who cannot wait, program 2 is my contribution for circle drawing. It will draw at any point on the screen a circle of any radius, either as a line drawing or as a filled shape. The program up to line 60 simply draws concentric circles using the procedure from line 60 onward. If you delete the first part of the program and renumber the procedure to say 20000 it would be useful in any program which called for circles. Whenever a circle was required, a call up like line 30 could be entered into the program, detailing in the parameter brackets, the *x* coordinate, the *Y* coordinate, the radius, and the character L or F (L

Program 2

```
 10 MODE 4
 20 FOR R=50 TO 500 STEP 50
 30 PROC_CIRCLE(640,512,R,"L")
 40 NEXT
 50 END
 60 DEFPROC_CIRCLE(X,Y,R,F$)
 70 IF F$="F" THEN 120
 80 MOVE X+R,Y
 90 FOR Z=0 TO 2*PI + 0.2 STEP 0.2
100 DRAW X+(R*COS(Z)),Y+(R*SIN(Z))
110 NEXT:ENDPROC
120 MOVE X,Y
130 DRAW X+R,Y
140 FOR Z=0TO 2*PI + 0.2 STEP 0.2
150 PLOT 85,X+(R*COS(Z)),Y+(R*SIN(Z))
160 MOVE X,Y
170 NEXT:ENDPROC
```

Program 3

```
 10 REM define the shape
 20 VDU 23,224,24,60,126,219,126,36,66,129
 30 REM place into variable
 40 V$=CHR$(224)
 50 REM switch to mode 5
 60 MODE 5
 70 REM print all over the screen
 80 FOR X = 1 TO 180
 90 REM with random colours
100 COLOUR RND(3)
110 PRINT V$;"  ";
120 NEXT
130 REM set white then end
140 COLOUR 3:END
```

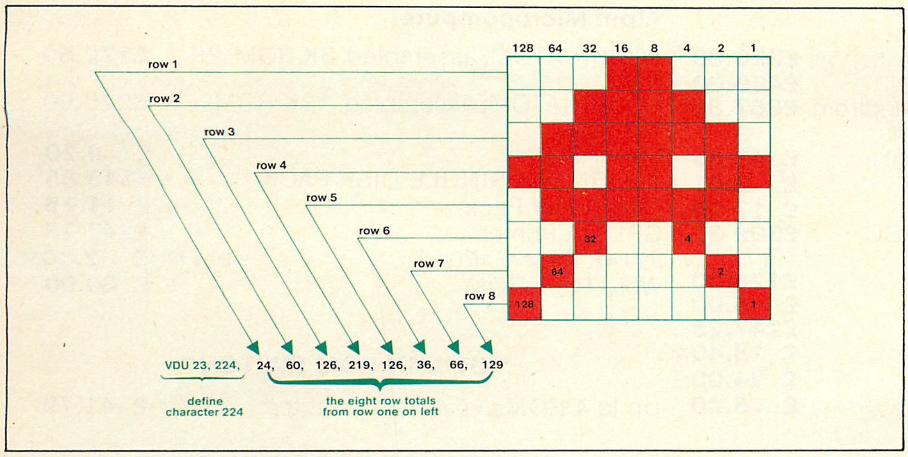


Figure 1 Designing user-defined graphics.

for line drawing or F for filled shape).

User-defined graphics

Moving shapes around the screen depends on the size of shape to be moved. In BASIC, a single character shape can be moved very quickly. Unfortunately, playing space war with letters representing alien ships is not overly exciting. To combat this, Acorn have included the option to define a number of characters from ASCII code 224 to 255. These defined characters may be displayed in modes zero to six and can be very effective.

A single user-defined shape fits into the screen space occupied by any single letter or digit, and is constructed on an eight by eight grid. Look at figure 1 which defines an alien from a well-known space game. In each row the filled blocks are given to numbers from the column headings, then the numbers assigned to each row are added together and entered into a VDU command line.

Program 3 demonstrates this and when run fills the screen with aliens. It is worth noting that having defined character 224 it would be lost if the computer was turned off. It would not be lost if the BREAK key was pressed. If it was redefined during a program then the previous shape would remain on the screen even while the new shape was being printed. This means that one user-defined character could produce a screenful of different shapes all visible together – but only the last defined shape would be capable of movement.

Because of this problem of movement, it would be best to have several shapes defined as different characters, so the first three new shapes would be defined as characters 224, 225 and 226. Having defined a shape, the next stage is to print it on the screen. This can be done with the command PRINT CHR$ (224). There is some value in placing the shape in a store, whose name can act as a mnemonic to the shape which it contains. So saying V$ = CHR$ (224) reminds me that PRINT V$ will print an inVader. This is done in program 3 line 40. ★

The next issue of *Acorn User* will feature hints and tips on sound and teletext-type graphics

ASCII CODES

American Standard Code for Information Interchange

32	SPACE	80	P
33	!	81	Q
34	"	82	R
35	#	83	S
36	$	84	T
37	%	85	U
38	&	86	V
39	'	87	W
40	(	88	X
41	)	89	Y
42	*	90	Z
43	+	91	[
44	,	92	\
45	–	93	]
46	.	94	^
47	/	95	_
48	Ø	96	£
49	1	97	a
50	2	98	b
51	3	99	c
52	4	100	d
53	5	101	e
54	6	102	f
55	7	103	g
56	8	104	h
57	9	105	i
58	:	106	j
59	;	107	k
60	<	108	l
61	=	109	m
62	>	110	n
63	?	111	o
64	@	112	p
65	A	113	q
66	B	114	r
67	C	115	s
68	D	116	t
69	E	117	u
70	F	118	v
71	G	119	w
72	H	120	x
73	I	121	y
74	J	122	z
75	K	123	{
76	L	124	¦
77	M	125	}
78	N	126	÷
79	O	127	DEL

SEEING STARS

This program plots geometric curves one inside the other, drawing triangles as it goes. The result is a star – a very pretty 1. Type it in and see for yourself!

```
 10 REM PRETTY1
 20 MODE2
 30 THETA=0
 40 A=RAD(120):B=A+A
 50 FOR M=4 TO 35
 60 PRINT;M;
 70 R=512
 80 VDU 29,640;512;
 90 FOR COL=0 TO 512/M:GCOLO,COL MOD 7 +1
100 MOVE R*COS(THETA),R*SIN(THETA)
110 MOVE R*COS(THETA+A),R*SIN(THETA+A)
120 PLOT&55,R*COS(THETA+B),R*SIN(THETA+B)
130 THETA=THETA+PI*2/M:R=R-M
140 NEXT
150 R=GET:CLS
160 NEXT
```

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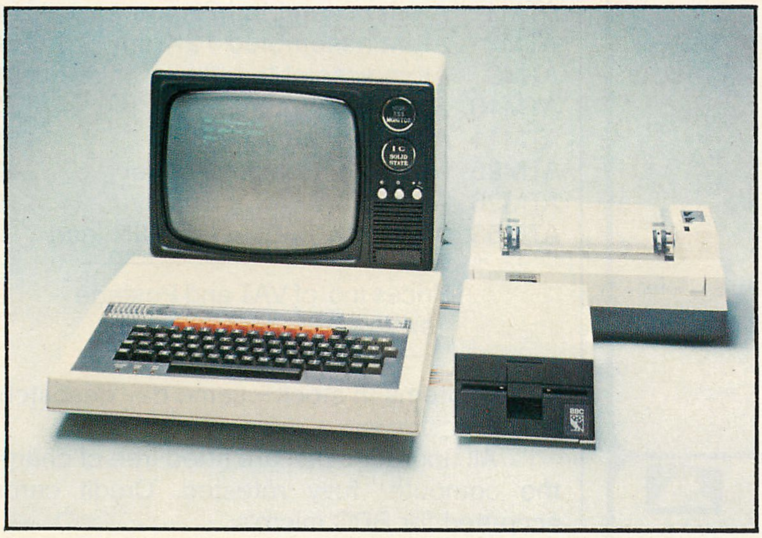
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Disc systems for the ATOM and BBC micro



BBC micro with single disc drive and printer. The cover shows a BBC micro with a double disc drive.

If, like me, you find using cassettes with your micro tedious then the recent announcement of disc systems for the Acorn Atom and BBC computer will be just what you have been waiting for.

No more fiddling with the volume control, no accidental overlapping of files, nothing lost by trying to record on the tape leader, and everything happens so much more quickly. Take loading a 16K program as an example. Using the disc on my BBC model B it takes three seconds! And it works without hiccups every time. A complete catalogue of the disc takes only one second!

If you have never used a disc system before, you probably find my euphoria a bit puzzling. Well, to put you in the picture, ponder on these facts for a moment or two.

- To get from one end of a tape to the other means winding the whole length of the tape past the read/write head. This takes time because there are umpteen feet of it. To perform more or less the same task the disc drive read/write head moves across the spinning disc. It covers a distance of about 1.5 inches and takes less than one second.
- The computer never knows where to find anything on a tape. You have to keep your own records using the tape counter. The disc system does this automatically; you only have to type a file name, the computer does the rest.
- To catalogue a tape means playing it all the way through. Cataloguing a disc is almost instantaneous.
- A special feature of the disc systems is *random access.* This feature allows you to read or write any small sections of a file.

The ATOM and BBC disc units are different products, but they have a lot in common. We will deal with each in turn.

The ATOM disc pack provides 92K bytes of storage on a standard 5.25" singled-sided 40-track floppy disc. It contains:

- An Olivetti disc-drive.
- The Disc Operating System (DOS) in ROM.
- An Acorn disc controller card.
- 3K bytes of RAM.
- 5v and 12v regulated power supplies.
- A comprehensive instruction manual.

The unit plugs directly into the mains electricity supply and into the ATOM bus-extension-socket. The ATOM needs modification before connecting the disc unit, and these changes are fully described in the manual. You can do them yourself or, they can be done by an Acorn dealer.

The disc supplied with the unit contains some useful utility programs, which are explained in the manual.

Some new facilities are provided with the disc system, including the 'DOS commands'. Direct commands are those you can enter from the keyboard. They must be preceded by a '*' which tells the computer that it is a DOS command. Filenames of up to 7 characters are allowed. The commands may be abbreviated as shown below.

*DOS *CAT *DIR *TITLE
*SETx *USEx *LOCK
*UNLOCK *INFO *MON
*NOMON *SAVE *LOAD
*DELETE *GO *RUN
*EXEC

The ATOM Disc Pack costs £345 including VAT, p & p by direct mail order from Acorn Computers.

Now some facts about the BBC Disc System. Either a single-side disc or a pair of 80 track double-sided discs are available for the BBC model B computer. These provide about 100K bytes and 800K bytes storage respectively. If you wish to upgrade your computer to a disc machine then this should be done by an Acorn dealer.

A comprehensive manual and a disc containing example programs and utilities are supplied in the disc pack.

Direct commands include the following:

*ACCESS *BACKUP *BUILD
*CAT *COMPACT *COPY
*DELETE *DESTROY *DIR
*DRIVE *DUMP *ENABLE
*EXEC *HELP *INFO *LIB
*LIST *LOAD *OPT 1 *OPT
4 *RENAME *RUN *SAVE
*SPOOL *TITLE *TYPE
*WIPE

All these are explained in the *Disc System User Guide* which also includes sections on Random Access Files and the use of the disc system with assembler language programs.

The single disc drive for the BBC micro costs £265 including VAT and can be ordered directly from Acorn Computers.

So whether you have an ATOM or a BBC micro, the tremendous advantages of a disc system are now open to you.

SOUND OUT THE BBC MICRO

By John Coll and Joe Telford

Contrary to much ill-informed comment, the SOUND and ENVELOPE statements are fully implemented in the BBC micro.

The new *User Guide* has full details, and here we give a rough outline plus example programs. The SOUND command is written as follows:

SOUND voice, volume, pitch, duration

There are four voices. Channel 0 gives white noise and channels 1,2,3 produce musical notes. Volume is a number from 0 (silence) to -15 (loudest). Pitch is a number from 0 (A-flat an octave below middle C) to 253 (D four octaves above middle C). The final number determines how long the noise will last. Hence the command

SOUND 1,-15, 53, 100

will produce a note on channel 1 at full volume, pitched at middle C for five seconds. See the new *User Guide* for notes produced by each value of pitch.

The two programs below left form the basis of four sound effects. The first will produce ten cycles of a Star Trek-type red alert. Altering the 150 in line 30 to 90 will change the sound to phaser fire. Note that the voice code is 17 which allows voice 1 to play glissando notes.

The second produces a siren sound. Replacing variable P in lines 40 and 50 with the number 100 as well as variable P in lines 80 and 90 with the number 50 will result in a different siren sound. For a more elegant effect try deleting lines 30 to 100 then adding these lines:

```
30 SOUND 1,-15,100,10
40 SOUND 1,-15,50,10
```

Voice 0 can be used to produce a large number of sounds. The program below is a synthesis of a steam train, complete with whistle, which demonstrates this white noise generator.

```
10 REM STAR TREK RED ALERT
20 FOR L = 1 TO 10
30   FOR P = 50 TO 150
40     SOUND 17,-15,P,2
50     NEXT
60   NEXT
```

```
10 REM SIRENS
20 FOR L = 1 TO 10
30   FOR P = 50 TO 100
40     SOUND 17,-15,P,2
50     SOUND 17,-15,P,2
60     NEXT
70   FOR P = 100 TO 50 STEP-1
80     SOUND 17,-15,P,2
90     SOUND 17,-15,P,2
100    NEXT
110  NEXT
```

```
10 REM TRAINS
20 REM START UP
30 FOR L = 20 TO 2 STEP -1
40   SOUND 0,-15,100,L
50   SOUND 0,0,100,L/2
60   NEXT
70 REM TRAVEL
80  FOR L = 1 TO 40
90   SOUND 0,-15,100,2
100  SOUND 0,0,100,2
110  NEXT
120 REM WHISTLE
130 SOUND1,-15,150,20
140 SOUND1,0,100,10
150 SOUND1,-15,150,20
160 REM CONTINUE TRAVELING
170 FOR L = 1 TO 40
180   SOUND 0,-15,100,2
190   SOUND 0,0,100,2
200   NEXT
210 REM SLOW DOWN
220 FOR L = 2 TO 20
230   SOUND 0,-15,100,L
240   SOUND 0,0,100,L/2
250   NEXT
```

The ENVELOPE statement is a dauntingly complicated beast. Instead of just playing a note at constant pitch and constant loudness, the ENVELOPE statement can change both the loudness and the pitch while a note is playing.

The combination of ENVELOPE and SOUND statements produce an all-singing, all-dancing, four-channel music generation circuit. It is even possible to use Econet to synchronise 10 computers while they play music and draw pictures on the screen!

The keyword ENVELOPE is followed by 14 numbers. An envelope has to be defined before it can be used in a SOUND statement – the ENVELOPE statement itself does not make any noise. You might like to try the following SOUND statement first without an envelope, and then with an envelope.

SOUND 1,-15,100,100

This will produce on sound channel 1, a note of maximum loudness, of pitch just about an octave above middle C and a duration of five seconds. Now try:

ENVELOPE 2,1,2,-1,1,10,20,10, 1, 0,0,-1,100,100

and then type in

SOUND I,2,100,100

This SOUND statement once again produces a note on Channel 1, but this time loudness and pitch are controlled by envelope 2 which have just been defined.

The 14 parameters that follow the keyword ENVELOPE are normally referred to by the following abbreviations.

ENVELOPE N,T,P11,P12,P13, PN1,PN2,PN3,AA,AD,AS,AR, ALA,ALD

The first two numbers indicate which envelope is being defined, and what length of time each step in the envelope is to take. The next six define the pitch envelope and the last six define the amplitude envelope. All the time a note is playing, its pitch is affected by the pitch envelope.

Normally the pitch envelope repeats over and over again, so one can generate a note which wails up and down for the whole

duration of the note. The pitch is controlled in three separate sections. Each consists of a number of steps. It is possible to specify the change of pitch at the end of each step and the number of steps in each section.

In the example envelope given above, the change in pitch at each step in the first section was an increase in pitch of two units. During the second section, the pitch changed -two units, in other words, it decreased by two. During the third section, the pitch once again increased by two units for each step.

In this envelope, there are 10 steps in the first section, 20 steps in the second, and 10 in the third. Experiment with the step sizes – large steps can give some very strange effects.

You might like to try some of the envelopes given below – but remember that the ENVELOPE statement merely sets up an envelope. You have to use a SOUND command to generate the note.

Also, the SOUND command must refer to the same envelope number defined. You may have four envelopes defined at the same time. These examples define envelopes numbers 1, 2, 3 and 4 and then SOUND commands can select from any of the defined envelopes.

```
ENVELOPE 1,25,16,12,8,1,1,1,
10,-10,0,-10,100,50
ENVELOPE 2,3,0,0,0,0,0,0,121,
-10,-5,-2,120,120
ENVELOPE 3,1,0,48,0,4,255,4,
121,-1,-1,-1,120,0
ENVELOPE 4,1,-26,-36,-45,255,
255,255,127,0,0,0,126,0
```

More on sound and envelopes in the next issue of *Acorn User.*

USER GROUP NEWS

From now on, we hope you will be able to get all the information you need about Acorn microcomputers from the official magazine, *Acorn User.* We hope that you will write to us with your ideas and problems, submit articles about your experience with Acorn micros (whether it is at home, in education or in business), send in listings for publication, submit software for review and let us know about local events in your area which might be of interest to other readers. The readership of *Acorn User* is by far the largest user group in existence for Acorn products.

There are, of course, several other user groups and we will be happy to give space to them in our magazine from time to time. *However this does not imply official Acorn approval.* This month we feature two user groups for the BBC microcomputer. Next month we hope to feature a number of local groups. If you are running a user group and would like a mention please contact *Acorn User* editorial offices.

BEEBUG NEWS
from Lee Calcraft

Beebug is an independent national user group whose main function – as we see it – is to act as an information exchange for the BBC micro. The machine offers so much potential (as yet unfulfilled) that such an exchange is vital – and is testified to by the size of our membership, which exceeded 4000 in May.

The medium for information exchange which Beebug provides is a newsletter (currently 28 pages) devoted entirely to the BBC machine. This is mailed to members 10 times a year.

Beebug is run by Sheridan Williams and myself. We are both coincidentally, in further education, and have no commercial or other axe to grind. We feel this independence allows us to represent members' interests in a way other groups cannot.

We have arranged a considerable number of discounts (up to 10%) for Beebug members with electronics, computer and book outlets. Members simply quote their membership number with order.

An important function of a national user group is to represent its membership on various issues in discussions with the machine's manufacturers. As readers of *Acorn User* will be aware, there have been teething troubles with the BBC machine.

In view of this, we carried out a survey of members on the question of machine ordering and supply, and the condition of machines at delivery. A good response was obtained, and most were delighted with the machine as conceived and designed, though many had experienced postal casualties such as keytops adrift, and some, more serious ones. We have taken up these issues with Acorn and joint managing director Chris Curry has given us assurances which we passed on to members.

If you would like a sample copy of Beebug newsletter, send £1 plus A5 SAE to: Beebug Subscription Dept, 374 Wandsworth Road, London, SW8 4TE. To join Beebug, send £4.90 for five issues (six months), or £8.90 for 10 issues (one year). (Overseas add £1.00 for six months or £1.50 for one year).

LASERBUG NEWS
from Jeff Weinrich

Formed in the early part of 1982, the name LASERBUG was derived from London and South East Region BBC Microcomputer User Group. Recently, many people from other parts of the UK have joined, so in future we will be known as LASERBUG, the Independent National BBC Microcomputer User Group. Membership is currently over 2000.

We want to encourage the exchange of ideas and discoveries. A monthly newsletter of at least 16 pages is sent to all user group members. We also recognise the need for meetings between BBC micro owners.

Membership is £12 per year and includes twelve issues of the newsletter and free entry to meetings. Alternatively, £1 will buy a sample copy of the newsletter (send a 9 x 15 inches s.a.e. with 16½p stamp). The address is LASERBUG, Station Bridge, Wood Grange Road, Forest Gate, London E7 ONF.

INTERFACING THE BBC MICRO

BY DAVID DUFF OF UNILAB

As enthusiasm for computers grew in schools, the demand arose for an interface to link scientific instruments to micros. The advantages are enormous – processing of data to give graphical results for anything from timing measurements to electrical, chemical and temperature readings. Such a versatile combination would also be capable of elaborate control tasks.

In 1980, a team at Unilab started work on just such an interface.

The team formulated a number of basic principals. Foremost was the idea that the interface must provide the user with new facilities. For example, time was not to be wasted producing pictures of analogue meters on television screens.

However, an instrument that could operate with the speed of a storage oscilloscope, had the capacity of a large data recorder and could plot with the resolution of a chart recorder would be a tremendous asset to the scientific computer user. With facilities included for digital input and output, analogue output and relays for switching power loads, we would also be creating a powerful control system.

A second basic principle was that the interface must use the computer's capabilities to the full. For example, if the computer could load data at 100,000 samples per second, the interface must be able to provide data at that rate or better.

The first part of the project to see the light of day was an analogue to digital converter. Initially the unit would process 40,000 samples per second, but later this was increased to 110,000.

As this unit was completed and tested, the power of the machine became apparent and it was realised that its scope would be considerably expanded if it had a multi-channel input and means for switching rapidly between channels. It was felt also that the instrument should be able to take input voltages over a wide range, implying the use of a number of input amplifiers. Eventually these ideas took shape in the form of a comprehensive analogue input block. Four independent inputs, A, B, C and D were provided to feed into a block of four independent amplifiers. The amplifiers provided ranges of 0-10 volts, 0-1 volt, 0-100mV and a variable range amplifier which could be set to any range between 0-25mV and 0-2.5 volts. Each amplifier could be set to operate on positive or bipolar (positive and negative signals).



As the list of facilities grew the feasibility of a hardware-based switching system diminished. Software control was clearly the answer and the first experiments were successful.

It was at this time that details about the BBC microcomputer started to emerge.

Subsequently a BBC micro was lent to the Unilab team and the necessary modifications were made to the interface. The high resolution graphics and advanced colour plotting pushed the whole project into another dimension.

Before long, the time taken to change interface mode was reduced from one millisecond to three microseconds. Thus the machine can now, for example, take an analogue reading from input A set at 0-10 volts, and three microseconds later take a digital input reading from input D. Three microseconds later the machine can be outputting analogue data through the analogue output.

It was now possible to make the control system extremely simple to use – as simple as assigning a value to a variable. This opened up a new field of applications, especially for the user who might wish to measure two or more functions almost simultaneously.

Many users have a particular interest in computers for control. It was felt the interface box should contain a means to switch relatively large currents on and off and this was achieved by four change-over relays linked to four of the eight data lines.

When a particular control system code is selected, the data on these four lines is latched to the relays. The interface can then do something else with the data lines and the latch will hold the relays in the positions selected until the computer instructs otherwise.

This ability to latch the relays is important. The user will almost certainly wish to operate the relays on the basis of measurements taken on analogue or digital inputs. Therefore the relays must 'hold' as directed while the computer uses the interface to take readings on inputs.

While trials and tests have been completed, production of the new interface is unlikely to be in full swing until the Autumn. Price is likely to be £100 to £150. Units as described above are already being demonstrated but final specifications may change slightly. *Acorn User* will keep you informed on the latest news.

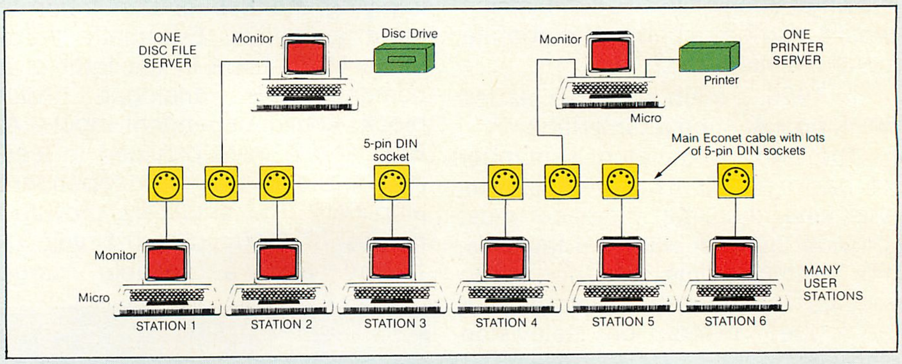
ECONET GOES TO SCHOOL

Peter Fenwick, Industrial Liaison Officer at Long Road Sixth Form College in Cambridge, describes a working network at the school.

Liaison between education and industry has been at the heart of a project at the Long Road Sixth Form College in Cambridge. Over the past year the school has played host to an early version of Econet – the Acorn local computer network. As well as providing the manufacturer with feedback, we have gained valuable expertise in working with networks – and raised some interesting questions about education itself (see *Times Education Supplement,* March 5).

In charge of computing in the college is Alan Battersby who has carried the work of evaluating Econet as well as coping with visitors interested in seeing a net that actually works.

The system operates with Acorn Atoms as workstations, although it is designed to cope with a suitably interfaced BBC machine. (The BBC micro/Econet interface will be available in August). An Acorn System 4 acts as network controller and it has dual disc drives which can be accessed from any workstation. A printer is attached to the network and a dedicated Atom acts as printer server. Six workstations are in use located in a single room.

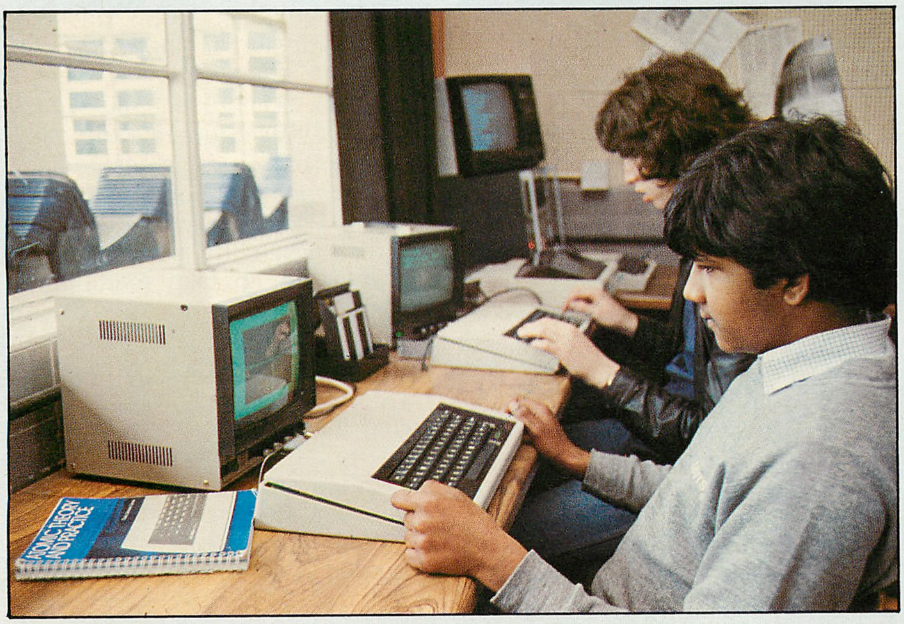


A schematic diagram of an Econet system. There may be over a hundred user stations, although only six are shown in the diagram.

This arrangement has found its chief application in the teaching of elementary computer studies, in computing as a general studies activity and in control projects. It provides an appreciable number of keyboards at a relatively low cost, sharing disc and printer facilities. First version software, though not sophisticated, has proved robust and sufficiently fast for current purposes (1-2 seconds to load an 8k program from disc into any workstation).

But two pressures have now arisen for us to make more ambitious use of Econet.

The first follows from the arrival of the BBC machine. With it, computer-aided learning software suitable for applications outside computer studies will appear. This will require the network to spread into other departments.



◄ Atomic theory on an Acorn Atom... BBC machines are on the way.



The pupils are using the Cambridge Local Education Authority device which enables them to trace a picture from a book or map directly onto the screen of the BBC micro.

The second results from our intention to set up a Technology Centre and service it with the Econet. An appeal for £30,000 is underway to build the Centre which will comprise an electronics laboratory, a support workshop and a photographic laboratory. Typical projects might include:

- building and controlling a robot arm;
- applications of speech synthesis and analysis;
- developing aids for the disabled;
- shape description and simple computer-aided design;
- design and production of printed circuit boards;
- control applications in the physical sciences;
- construction of an *xy* plotter.

The logic behind the Centre is the need for a project area that clearly belongs to the whole college, rather than to any particular department and where activities outside the curriculum can be pursued.

Behind its creation lurk many questions about the kind of education young people should be receiving. Is the academic curriculum an adequate basis of preparation? Are courses sufficiently relevant to the future they will experience and influence?

An extra dimension to the Technology Centre, and perhaps a potential response to these questions, is the involvement of advisers from local industry, commerce and education. Their influence should give pupils insight into the methods and practices of industry, relate academic subjects to practical achievement, and provide experience of working in a team.

Both demands imply a major geographical expansion of the network from its present one-room size to an estimated 0.7km. Acorn have offered to help with installation of wiring and with Version 2 Econet software. There is also a clear need for hard discs.

One expected result is need for higher quality wiring. At present the network uses simple twisted-pair cable, but a greater length will probably require coaxial cable.

An obvious result is increasing traffic on the network. To obtain a busy signal on the system is rare, but will be less so as more users clock in. We may discover a practical limit to the system, whereas the theoretical limit of 255 stations per network is well established.

The temptation for a totally 'wired' school will probably be blocked by major administrative problems such as overloading, excessive demand on disc capacity and security.

Nevertheless, our experience encourages us to push on with Econet. Version 2 software offers exciting possibilities as do proposed Telesoftware trials.

In describing our experiences I may have gone beyond the apparent needs of many schools and colleges. However, the experience at Long Road suggests that Econet and the BBC microcomputer will offer a flexible, powerful and low-cost solution to many of the hardware demands in the education sector.

Your Letters

I have now had my Model B BBC micro for about a month and from my initial experience I should like to raise a query. With respect to the programs on the Welcome cassette, and use of television receivers instead of monitors, no account seems to have been taken of the overscan of current sets and the lack of accessibility of frame height adjustments, with the result that the top line of the display is lost. Can you help?

You might be interested to know one command which is available on the machine, though not documented in the provisional guide, which enables one to move the whole television picture either up or down the screen. If you issue the command

***TV 254**

and then change mode the whole screen will move down two lines. This may help to place the television image centrally on the screen. The change of place only comes into effect the next time the mode is changed. You can move the image down the screen with numbers like 255,254 or 253 and move the image up the screen with numbers like 1, 2 and 3. *TV 0 returns the image to its normal position.

I have recently taken delivery of a Model A BBC micro. Although my present colour television will not accept Teletext transmissions, I am hoping to purchase a Teletext Receiver from Acorn. If I order one of these Receivers, will I be able to get the Teletext transmissions on my present set? Will I be able to run Telesoftware programs on my computer without typing them in? How do you change pages and channels? Is there a remote control facility? Will I require any additional equipment?

We confirm that the Teletext unit is a separate unit but it plugs directly into a Model B computer. It is not possible to connect it to an unmodified Model A. You can use it to view all the normal Teletext pages as well as to load computer programs sent as Telesoftware. To select a new page you just type the page number on the computer keyboard. There is no remote control unit. No additional equipment is needed – it is all included in the Teletext unit. Just as a last comment, it is not possible to use an ordinary Teletext television with the computer. They simply were not designed to work in that way.

I received my BBC micro last week. I am very pleased with it as it has lived up to all the brilliant reviews it got in the computing press. However, when the computer arrived, four of the letter keys and the space bar were lying in the bottom of the box. I managed to put the letter keys on again but the space bar was a little more tricky. So I tried to take off the lid – if it were not for the three red LEDs jammed onto the front console this would probably have been quite easy.

We are sorry to hear that your computer arrived with several keys loose. Acorn clearly underestimated the destructive powers of the post! The packaging has now been changed to include a thick piece of foam over the keyboard and we believe that this has solved the keyboard and LED problem.

Whether you would like to have a question answered or just to air your views, write to us at *Acorn User*, 53 Bedford Square, London WC1B 3DZ. The Editor reserves the right to amend or alter any letter prior to publication.

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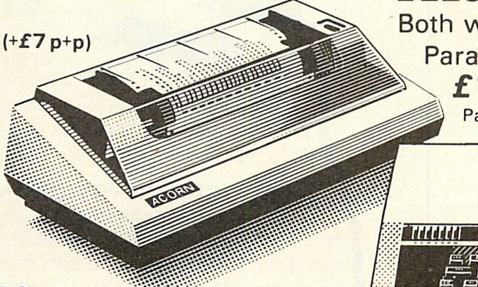
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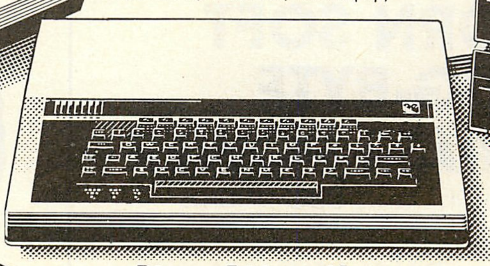
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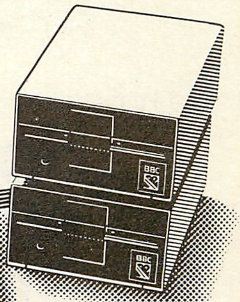
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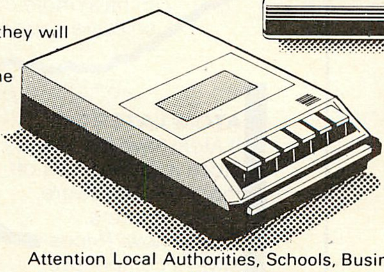
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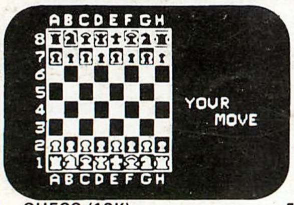
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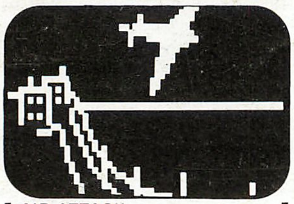
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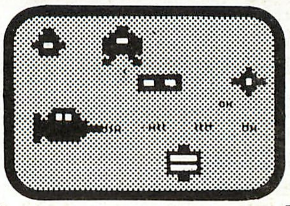




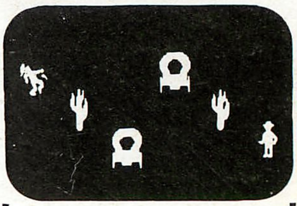
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